# A SYSTEMS ANALYSIS OF

# AN URBAN TRANSPORTATION PROBLEM

BY

MICHAEL JOHN MARKOW
SB, Massachusetts Institute of Technology
(1968)

Submitted in partial fulfillment
of the requirements for the degree of
Master of Science

at the

Massachusetts Institute of Technology
September, 1969

Signature of Author . . . . . . . . . . . . . . . . . . . .
Department of Civil Engineering, August 18, 1969

Certified by. . . . . . . . . . . . . . . . . . . . . . .
Thesis Supervisor

Accepted by . . . . . . . . . . . . . . . . . . . . . . .
Chairman, Departmental Committee on Graduate Students

## ABSTRACT

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Submitted to the Department of Civil Engineering on August 18, 1969, in partial fulfillment of the requirements for the degree of Master of Science.

The systems analysis approach is used to formulate a preliminary transportation plan for a New Community on the Boston Harbor islands. Specifically, the following three areas are investigated:

1. The existing transportation system in Boston, and the proposed 1975 system;

2. The requirements placed upon the New Community system by users and by land constraints;

3. The system response to these requirements.

Preliminary analysis indicates the feasibility of access to the Community via a bridge at Columbia Point. An expressway to be used by both automobiles and express buses will link the Harbor islands. Demand for rail rapid transit is not envisioned.


Thesis Supervisor: Fred Moavenzadeh

Title: Associate Professor of Civil Engineering

## ACKNOWLEDGEMENTS

The work reported herein was sponsored by the Urban Systems Laboratory of MIT under the "New Community Project." The support of the Laboratory is greatly appreciated.

I would like to express personal thanks to all who helped me this past year on this project. Particular thanks go to Professor Fred Moavenzadeh for his supervision and guidance; to Professor John Clarkeson for his suggestions and assistance in preparing cost estimates; to Mr. David Hughes for his help in developing the content and style of the draft; and especially to Mrs. Elizabeth McHugh for the wonderful job she did typing this report.

CONTENTS

| | Page |
|---|---|
| Title Page | 1 |
| Abstract | 2 |
| Acknowledgement | 3 |
| Table of Contents | 4 |
| Body of Text | 6 |
| 1.0 Statement of Problem | 6 |
| 2.0 Metropolitan Transportation Network | 8 |
| 2.1 Existing Vehicular Routes | |
| 2.2 Proposed 1975 Network | |
| 2.3 Existing Transit Lines | |
| 2.4 Proposed 1975 System | |
| 3.0 Organic Aspects | 14 |
| 3.1 Transportation - Land Use Relationship | |
| 3.2 New Community Travel Desires | |
| 3.3 Location of Routes to Fit Desire Lines | |
| 3.4 Projected Peak Hour Demands | |
| 3.5 Alternative Solutions (Modes) | |
| 3.6 New Strategies | |
| 3.7 Environmental Matters | |
| 3.8 Chapter Summary | |
| 4.0 Technical/Physical Aspects | 76 |
| 4.1 Modal Characteristics | |
| 4.2 Trip Profiles | |
| 4.3 Trip Profile Comparisons | |
| 4.4 Physical Characteristics of Facilities | |
| 4.5 Coordination With Mainland Expressways | |
| 5.0 Evaluation and Conclusions | 88 |
| 5.1 Private Automobile System | |
| 5.2 Public Transit System | |
| 5.3 Preliminary Transportation Plan | |

References . . . . . . . . . . 92

Appendices. . . . . . . . . . . 95

List of Figures

List of Tables

Tables Pertaining to the Report

## 1.0 STATEMENT OF PROBLEM

The Urban Systems Laboratory of MIT is performing engineering, social, and economic studies for a proposed New Community in Boston Harbor. One of the major areas of study is transportation -- both access to, and movement within, the Community.

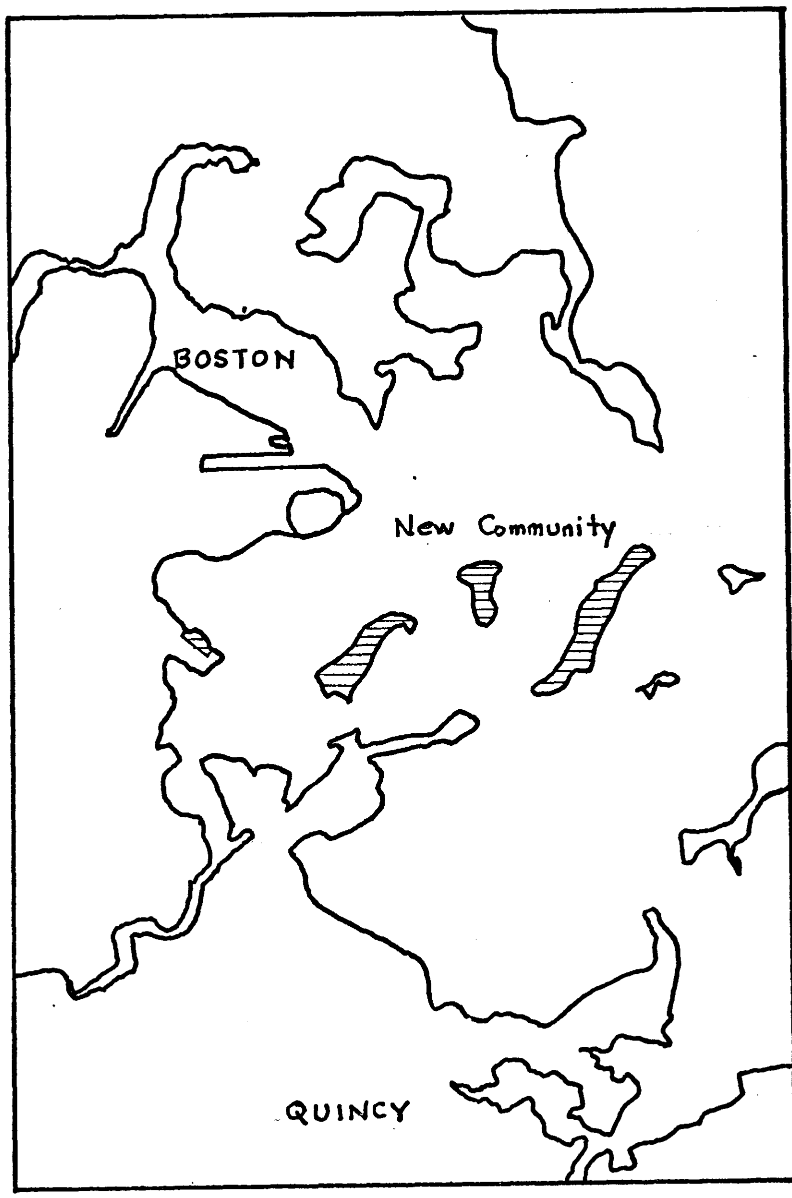
The goal of this paper is the formulation of a preliminary transportation plan for the Community. Using a systems analysis approach, we will define objectives to be met by the transportation facilities, list alternative solutions, and evaluate them.

Figure I is a map showing the location of the proposed Community. The 500-acre site consists of three Harbor islands and the northern portion of Columbia Point.

The New Community will house about 42,000 persons of mixed incomes. These people will enjoy the benefits of a new, modern, planned city. It is hoped the New Community will serve as an "urban laboratory" in leading the way for other new towns and in demonstrating new techniques for meeting the problems of today's cities.

Our approach to the New Community transportation problem is in four stages. Chapter 2 gives an overall picture of existing transportation networks in Boston, and what is likely to exist by 1975. Chapter 3 relates transportation to the social topics of user demands and Community land use. Chapter 4 examines the physical and technical aspects of proposed systems, seeing what is available to meet the demands posed in Chapter 3. Finally, Chapter 5 contains our evaluation and conclusions.

FIGURE 1. PROPOSED NEW COMMUNITY SITE



## 2.0 METROPOLITAN TRANSPORTATION NETWORK

### 2.1 Existing Vehicular Routes

Figure 2 shows existing vehicular routes in the vicinity of the New Community site. Access north and south is provided by the Southeast Expressway, Morrissey Boulevard, and Route 3A. East-west travel is served either by Route 128 or by highways entering downtown Boston from the west.

### 2.2 Proposed 1975 Network

Figure 3 shows the 1975 network as now envisioned by the Massachusetts Department of Public Works. Proposed improvements include completion of I-95 and construction of the Inner Belt in Boston and Cambridge. Also under discussion at the present time are a third harbor tunnel, and an I-95 bypass to relieve the Central Artery.

Although plans for some of these highways are in the final design stage, there is danger that controversy may prevent parts of the system from being completed on time. Jamaica Plain residents have objected to the elevated portion of I-95 through their neighborhood, and Cambridge's opposition to the Inner Belt has thrown the project back to the "study" stage.

These delays have serious implications if traffic volume on the Southeast Expressway continues to grow, and no improvements are made in the road system to help it.

### 2.3 Existing Transit Lines

Figure 4 shows the present rapid transit system. The New Community site is served by Columbia Station on the Harvard-Ashmont line (Red Line).

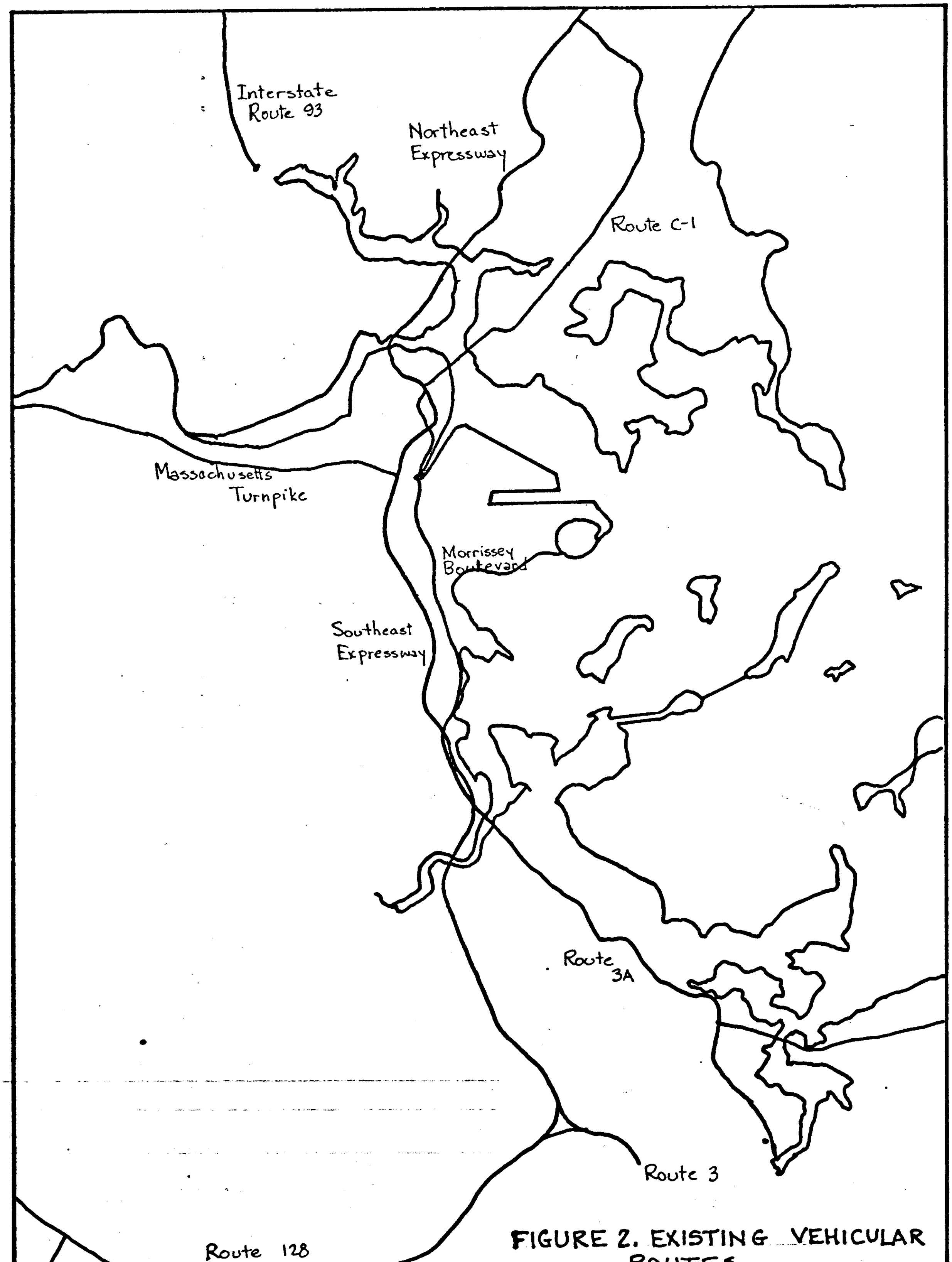



FIGURE 2. EXISTING VEHICULAR ROUTES

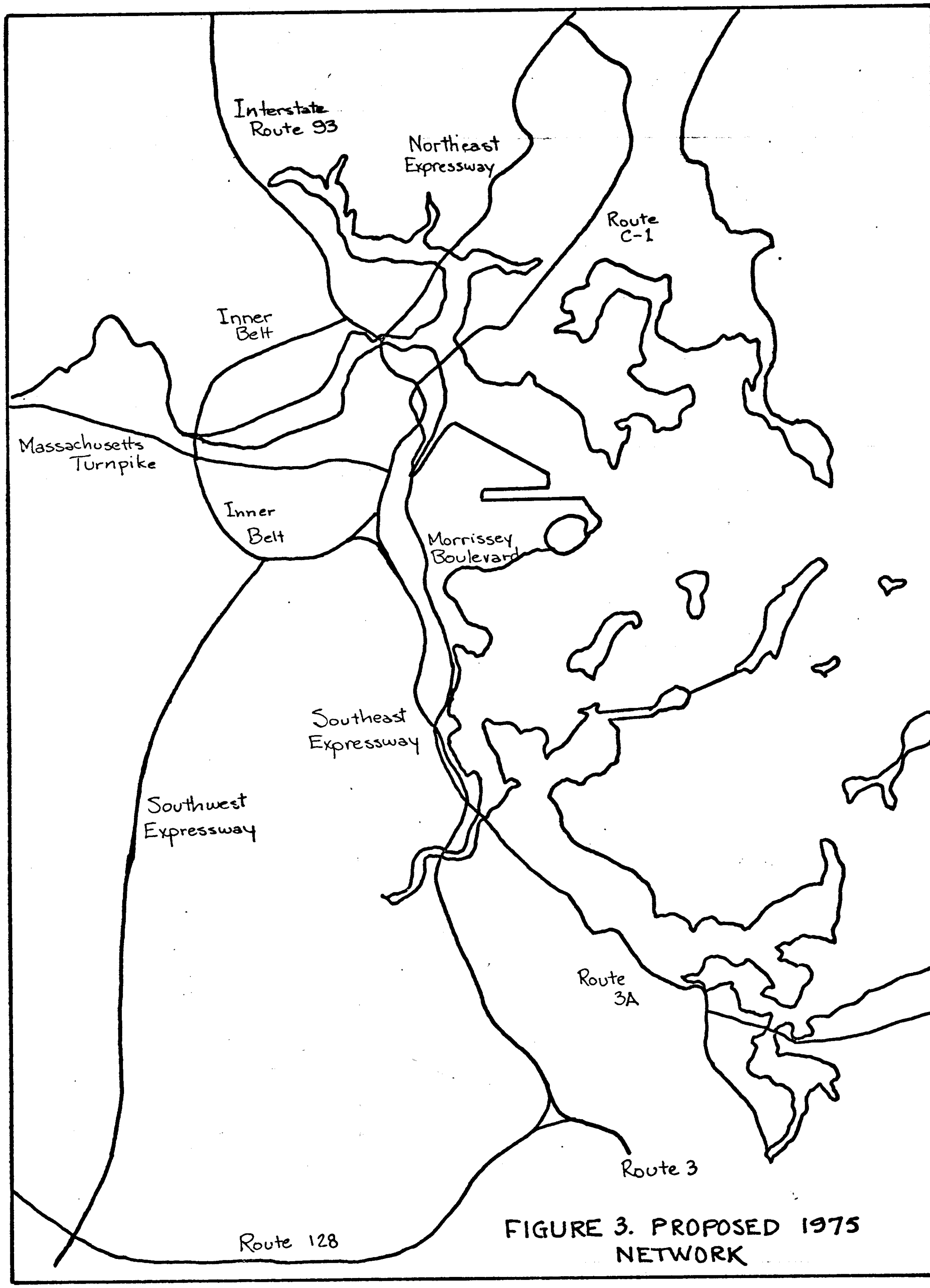



FIGURE 3. PROPOSED 1975
NETWORK

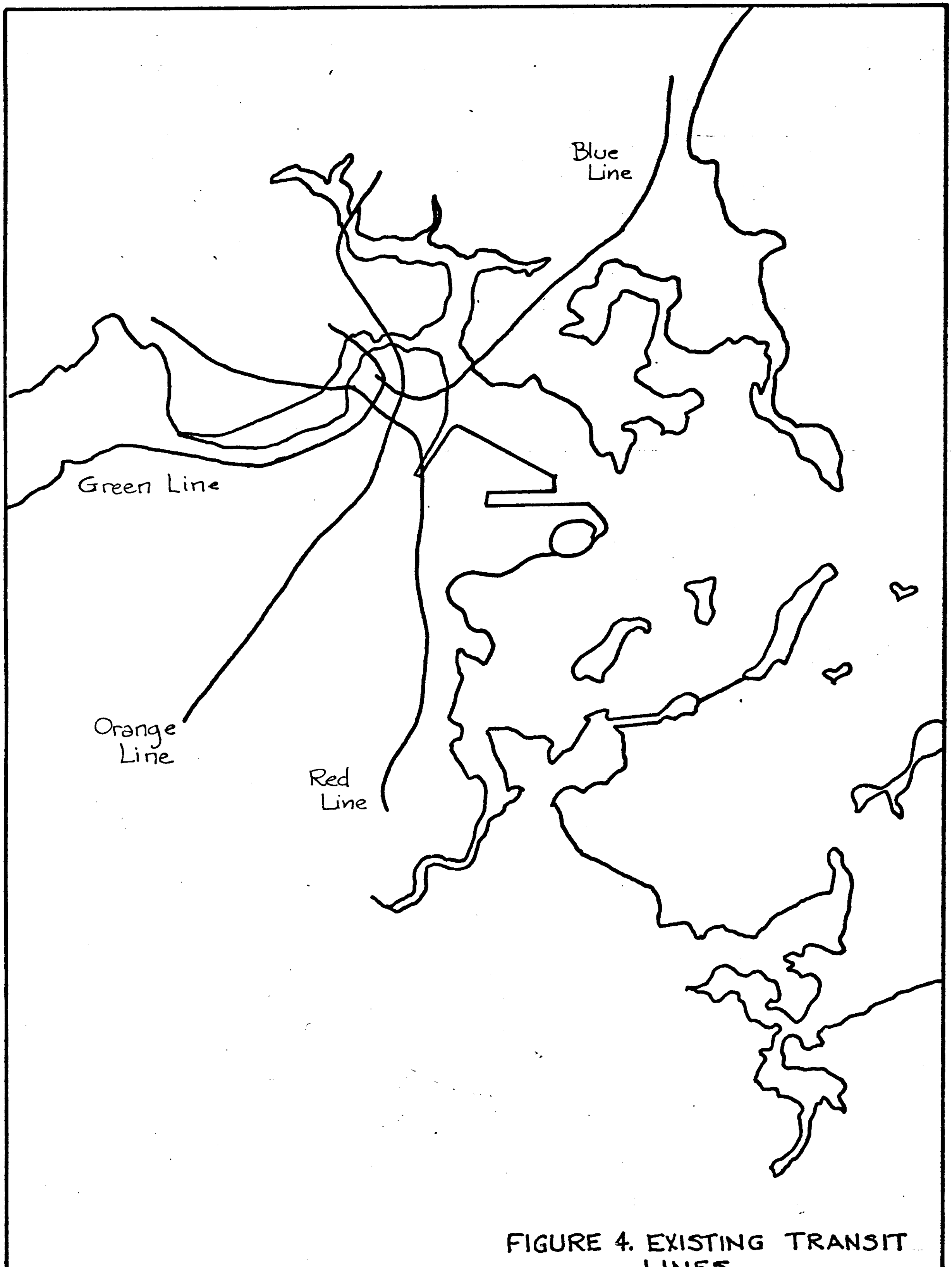



FIGURE 4. EXISTING TRANSIT
LINES

## 2.4 Proposed 1975 System

Figure 5 outlines the MBTA's Master Plan for 1975. The MBTA proposes expansion of the Orange, Red, and Green Lines, and other service improvements. Of particular relevance to the New Community is the Red Line South Shore extension, which will merge with the Harvard-Ashmont line at Columbia Station. When the South Shore extension is completed in 1973, the New Community site will have direct rapid transit access to all points from Braintree to Boston.

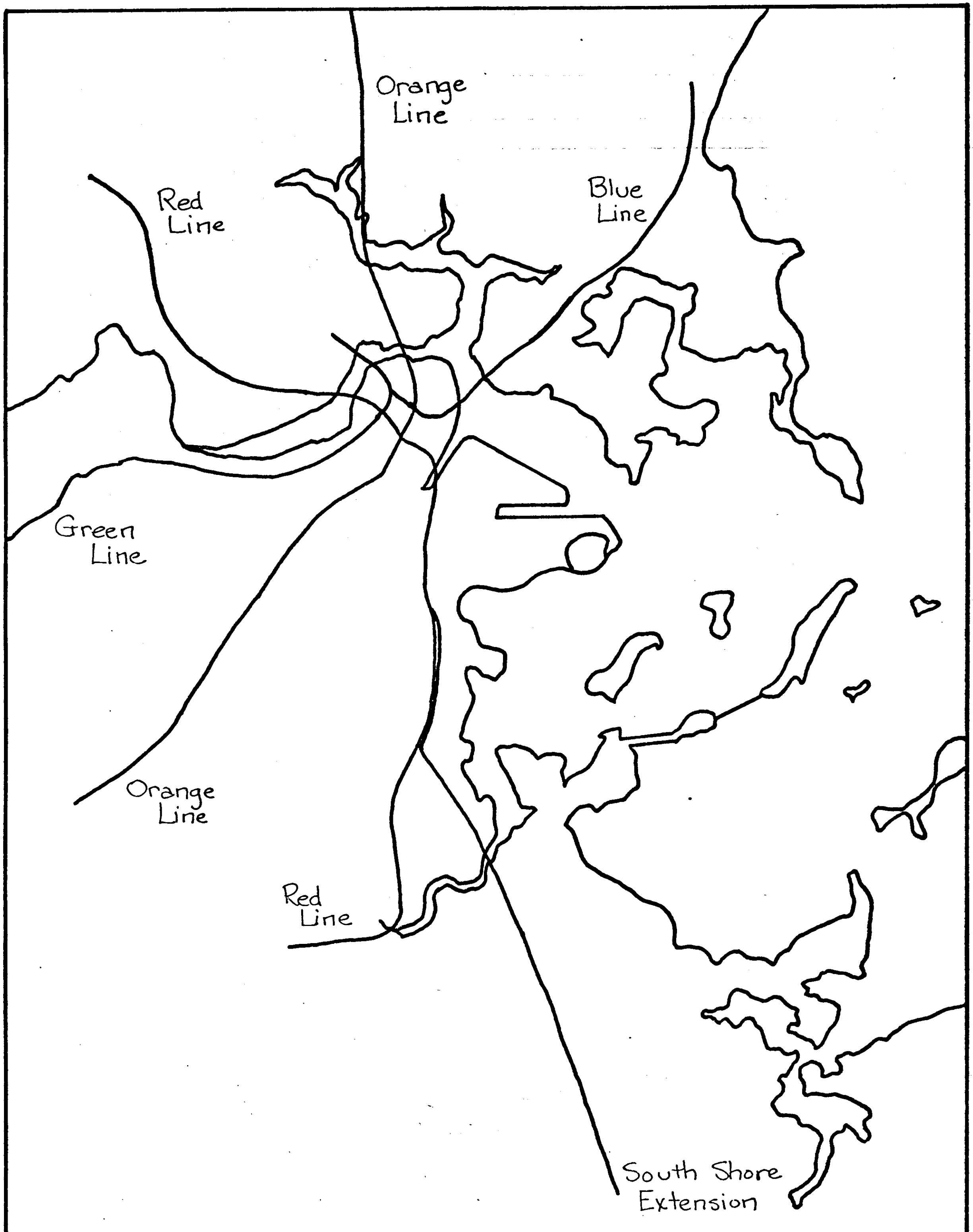



FIGURE 5. PROPOSED 1975 TRANSIT SYSTEM

## 3.0 ORGANIC ASPECTS

Organic aspects relate to the life and growth of the New Community. To a transportation planner, Community life and growth means more than the swift, efficient, and comfortable movement of the travelling public. It also means the harmonizing of transportation with the total environment, and the satisfaction of the non-user as well as the user.

With the above definitions as chapter guidelines, we will first investigate the transportation - land use relationship. We will then determine user demands on the transportation system. Finally, we will suggest possible alternative transportation systems and policies.

### 3.1 Transportation - Land Use Relationship

Transportation and land use interract at two separate levels. At the first level, the functional level, the land use arrangement helps determine travel patterns. Conversely, the transportation system constructed to meet these patterns helps determine areas of future growth.

At the second, or physical level, the transportation facilities -- road pavement, transit rails, terminals -- are themselves land users and are a permanent part of the urban land pattern. The physical interaction becomes significant when, as in the New Community, land is scarce.

#### 3.1.1 Functional Interaction

Under the functional interaction we will discuss trip volumes, trip lengths, and effects of residential population and density.

3.1.1.1 Trip Volumes

We have studied the influences of three different New Community land use plans on projected peak hour traffic volumes. The results of this study appear in Section 3.4.

Barton-Aschman Associates ( 3 ) emphasize the importance of coordinated transportation and land use planning in designing for these peak hour loads, especially in dense urban areas. Problems of parking and congestion have made sections of some cities obsolete, with the only solution so far being wholesale rebuilding.

The pertinence of this fact to the New Community is that a sufficient amount of extra land, or provisions for increased capacity, should be planned now for future expansion of the transportation system.

3.1.1.2 Trip Lengths

A study by Alan Voorhees (38) recommends reducing average trip lengths through proper arrangement of land uses. Since average trip lengths directly influence transportation requirements, it follows that good land use planning leads to transportation economies.

Some authorities believe the goal of transportation is simply an increase in mobility, *per se*. However, if increased mobility provides no additional service it is useless. (There is no benefit in travelling seven miles to work rather than five unless the job opportunities or choices of residence are thereby increased.) On the other hand, to shorten trip lengths while providing similar opportunities is a worthwhile objective in terms of convenience and economy.

It is advantageous, then, to locate as many employment, shopping, and recreational centers as possible within the New Community. Furthermore, these centers should be situated as close as possible to high density residential areas. Finally, the street and rail patterns should focus on areas of present and future commercial development.

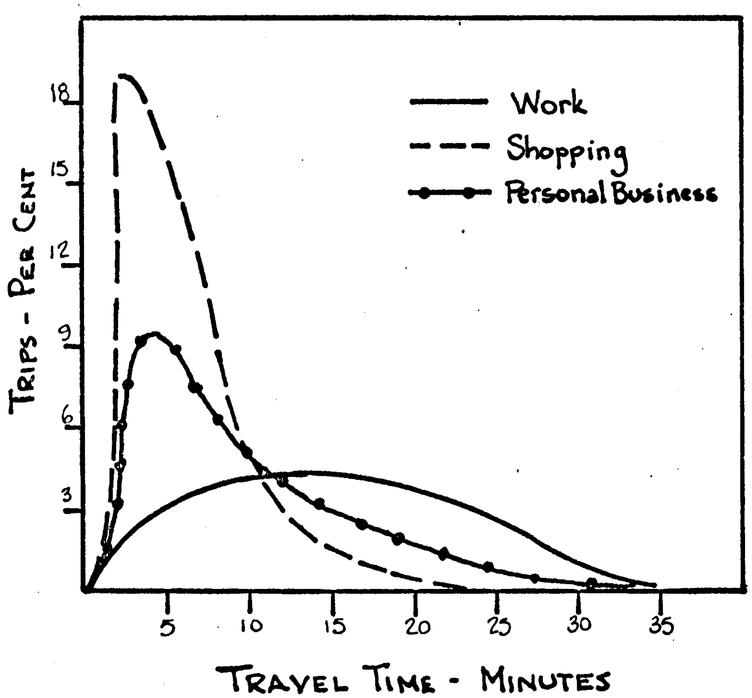
### 3.1.1.3 Residential Population and Density

Referring to the above conclusions, there are upper limits to the amount of employment and commercial services which can locate within the New Community. Aside from restrictions of available land, these facilities require a certain size labor pool or market. For example, 1000-2000 families are needed to support a local shopping center.

As a result of this fact, Alan Voorhees finds that the smaller the city, the higher the percentage of trips crossing the city limits. In other words, small communities cannot provide all the job and commercial centers required by their inhabitants for daily living.

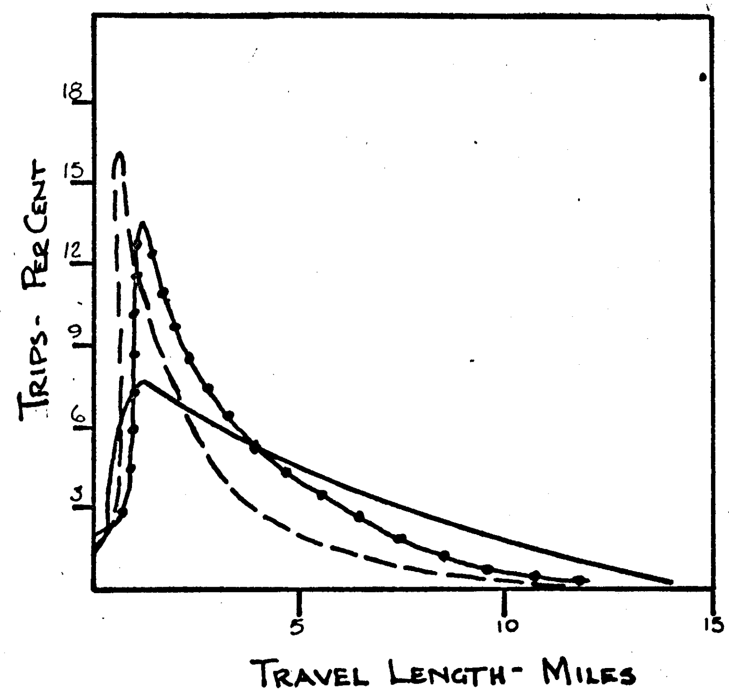
On the other hand, in large cities (population 100,000 or more), the percentage of trips crossing the city boundary levels off at about 65 per cent. Voorhees contends that the other 35 per cent of the trips are work trips or long social-recreational trips.

These findings are supported by Stanford Research Institute (14). See Figures 6 and 7. Figure 6 (from a Baltimore transportation study) shows shopping and personal business trips heavily peaked at 3 to 4 minutes' duration, and dropping off rapidly above 10 minutes' duration. Given today's residential densities, typically 100,000 people are included in a 10-minute




Source: Reference 14

FIGURE 6. TRAVEL TIME DISTRIBUTION




Source: Reference 14

FIGURE 7. TRIP LENGTH DISTRIBUTION

radius. Work trips, however, have a less pronounced peak at 15 minutes' duration and begin losing significance at about 25 or 30 minutes' duration. Figure 7 (from a Wisconsin transportation study) shows similar patterns in terms of trip length.

The implications of these findings to the New Community are that (1) the New Community will be dependent upon the City of Boston and the mainland in general for some employment and probably some commercial activities (e.g. expensive clothing, automobiles, furniture); (2) the New Community land use pattern should reflect the demonstrated public preference for short (i.e. neighborhood) shopping and personal business trips.

### 3.1.2 Physical Interaction

The land area devoted to transportation in large American cities is typically 10 to 15 per cent of the total city acreage. See Table 1.

TABLE I

PER CENT OF URBAN LAND DEVOTED TO TRANSPORTATION

LAND USE

| City | Transportation, Communications, Utilities | Parking and Miscellaneous | Streets and Alleys | Total |
|---|---|---|---|---|
| New York | 4.7 | 0.2 | 30.1 | 35.0 |
| Baltimore | - | - | 6.0 | 6.0 |
| Chicago | 4.1 | 0.1 | 11.8 | 16.0 |
| Detroit | - | 1.0 | 14.8 | 15.8 |
| Pittsburgh | 2.5 | - | 10.9 | 13.4 |
| Minneapolis | 2.2 | - | 8.1 | 10.3 |
| Nashville | 3.4 | - | 6.0 | 10.3 |
| Chattanooga | - | - | 9.5 | 9.5 |

If "developed land" is used as the standard instead of "total land," these percentages double or triple, averaging about 30 per cent. See Table 2.

TABLE 2

PER CENT OF DEVELOPED URBAN LAND DEVOTED TO TRANSPORTATION LAND USE

| City | Transportation, Communications, Utilities | Parking and Miscellaneous | Streets and Alleys | Total |
|---|---|---|---|---|
| New York | 5.4 | 0.2 | 34.6 | 40.2 |
| Baltimore | - | - | 16.6 | 16.6 |
| Chicago | 9.0 | 0.3 | 25.9 | 35.2 |
| Detroit | - | 2.2 | 30.8 | 33.0 |
| Pittsburgh | 5.8 | - | 25.0 | 30.8 |
| Minneapolis | 8.1 | - | 29.1 | 38.0 |
| Nashville | 6.9 | - | 14.1 | 21.0 |
| Chattanooga | - | - | 23.9 | 23.9 |

Using the assumptions under which Tables 1 and 2 were compiled, the New Community is "totally developed"; that is, developed land equals the total available land. (Open space is included in developed land because it is serving a particular urban function -- recreation area or scenery. Undeveloped land would include parcels such as vacant lots, unused beaches, or wildlands not designated as recreation areas.)

This relative scarcity of free land imposes tight constraints on the Community transportation system. Thirty per cent of the proposed developed land (30% of 550 acres) is an investment of about 165 acreas toward transportation. Subtracting the 50 acres allotted to transportation in the preliminary land use plan, 115 of the 270 residential acres must be devoted to streets and alleys.

Clearly, the physical organization of the New Community will have to be different from that of existing cities. One approach might be toward multiple use of space -- utilization of air rights over travelways, for example. A second approach might be toward elimination of streets and alleys, to which most of the urban transportation land is directed today.

### 3.1.2.1 Multiple Use of Land

The concept of multiple use of space has been gaining increased acceptance in cities from the points of view of both land savings and aesthetics. The Massachusetts Turnpike Extension, for example, leases air rights to private developers. In addition, the Turnpike Extension is an example of a combined auto-rail transportation corridor, an idea introduced in Chicago and embodied in Boston's I-95/MBTA Orange Line Extension. Further examples of multiple use are the modernistic bus terminal above the eastern approach to the George Washington Bridge in New York, a riverside park located over the multilevel Brooklyn-Queens Expressway in Brooklyn, and the system of linear parks stretching beneath the elevated portions of San Francisco's BART system.

What these examples show is that the multiple use concept is both workable and socially acceptable. The chief constraint on its use in the New Community is likely to be economic. Some suggestions for multiple use schemes are presented in Section 4.4.1.

### 3.1.2.2 Elimination of Streets and Alleys

The elimination of streets and alleys appears to be a physically, socially, and economically acceptable strategy. It is physically acceptable because streets and alleys constitute from 75 to almost 100 per cent of urban land area used for transportation. It has been shown to be socially and economically viable in developments such as the large apartment projects in New York City, where a system of small private roads, walkways, and parking areas (underground and peripheral) supply internal transportation needs.

The implications of this strategy on the housing plan of the New Community are (1) the discarding of the traditional city block layout in favor of either a clustering of apartment towers around a main access facility, or a series of "superblocks"; (2) the facing of building entrances toward plazas or terraces, rather than streets; and (3) the increased emphasis on personal transportation (from the main access facility to the home). The latter point may be dealt with in a number of ways: ordinary, covered, or moving sidewalks, basement garages with elevator service, or very small private paths for the exclusive use of minibuses.

### 3.1.3 Summary

The New Community will draw upon employment and consumer services from both its own resources and the mainland. These facilities located within the Community should be placed as close as possible to the high density residential areas to reduce transportation requirements.

The scarcity of land at the New Community site dictates that a smaller than usual percentage be devoted to transportation. Economizing on land can be effected by (1) constructing multi-level, multi-purpose facilities; and (2) creating a city plan with as few streets as possible.

3.2 New Community Travel Desires

This development of tentative New Community travel desires makes extensive use of Boston's Comprehensive Transportation Inventory conducted in 1963 by Wilbur Smith. We have concentrated on this Transportation Inventory -- that is, the trip-making habits of the Boston area population itself -- rather than using trip generation models or modal split models which appear in the literature. Previous trials with several of these models give answers over too wide a range to be useful. This range is probably the result of a combination of factors:

(1) models developed for one city are not necessarily valid for another;

(2) general models derived from the data of several cities lose, in the averaging process, their applicability to particular cities;

(3) the New Community characteristics (density, population distribution), which are numerical assumptions on paper rather than the results of natural urban growth, may violate some assumptions inherent in urban transportation models.

3.2.1 Use of the Transportation Inventory Data: Assumptions

The predictions resulting from the use of the Inventory data are based on a level of service comparable to that in the Boston region today. We have assumed that such predictions are accurate enough for first estimates of New Community travel desires. These estimates can be revised later to account for the higher level of service -- e.g. better roads, newer buses or subway cars -- that can be expected in the New Community.

The Wilbur Smith study area encompasses Boston and a large part of the surrounding Eastern Massachusetts region. The population in the study area exceeds three million. To check the applicability of the Wilbur Smith data to our New Community, two demographic comparisons were made. See Tables 3 and 4.

TABLE 3

INCOME DISTRIBUTION--NEW COMMUNITY AND STUDY AREA

| Range | New Community | Study Area (excluding unknowns*) |
|---|---|---|
| 0 - $4000 | 10% | 19.1% |
| 4 - 7000 | 30% | 36.8% |
| 7 - 10000 | 30% | 24.8% |
| 10- 15000 | 20% | 13.1% |
| 15000 or over | 10% | 6.2% |

*unknowns are those who did not report their incomes

TABLE 4

AGE DISTRIBUTION--NEW COMMUNITY AND STUDY AREA

| Range | New Community | Study Area |
|---|---|---|
| Under 15 years | 33.8% | 31.7% |
| 16 - 29 | 55.4% | 18.4% |
| 30 - 59 | | 36.6% |
| 60 or over | 10.8% | 13.3% |

At least in the cases of income and age distribution, the New Community does not exhibit any imbalance compared to the study area. We feel use of the study area information is justified at this stage of prediction.

### 3.2.2 Application of the Transportation Inventory Data

#### 3.2.2.1 Auto Ownership

Table 5 shows auto ownership in the study area as a function of income area and family size. Table 6 applies these ownership rates to the projected New Community population. Because the New Community population closely mirrors the study area population, auto ownership is likewise similar. Table 5 shows an overall rate of 1.108 cars per family in the Boston area, while Table 6 shows an average of 1.14 cars per family in the New Community. We project that New Community inhabitants will own 14,340 autos.

#### 3.2.2.2 Total Trip Generation

Wilbur Smith finds that a linear relationship exists between auto ownership and total trip production by a family. (Total trip production here means number of trips taken by any mode except walking, for any purpose, during one day.) Knowing the New Community auto ownership, we can estimate total daily trip production. See Table 7.

#### 3.2.2.3 Trip Purpose and Mode

Table 8 shows the breakdown of total trips (by purpose at destination) for each mode. The percentages shown are those obtained from the Wilbur Smith report; the numbers are projected New Community daily trips.

TABLE 5

AVERAGE NUMBER OF CARS PER HOUSEHOLD:
BOSTON URBAN REGION

INCOME RANGE
(Thousands of Dollars)

| Persons Per Household | 0 -4 | 4 -7 | 7 -10 | 10-15 | 15+ | Average for All Incomes |
|---|---|---|---|---|---|---|
| 1 | 0.200 | 0.516 | 0.685 | 0.802 | 0.667 | 0.333 |
| 2 | 0.441 | 0.829 | 1.066 | 1.233 | 1.436 | 0.846 |
| 1 - 2 | 0.345 | 0.778 | 1.037 | 1.206 | 1.382 | 0.734 |
| 3 | 0.582 | 0.982 | 1.258 | 1.470 | 1.820 | 1.112 |
| 4 | 0.663 | 1.043 | 1.305 | 1.581 | 1.935 | 1.252 |
| 3 - 4 | 0.615 | 1.015 | 1.287 | 1.533 | 1.886 | 1.189 |
| 5 | 0.597 | 1.021 | 1.286 | 1.565 | 2.006 | 1.239 |
| All Households | 0.453 | 0.971 | 1.248 | 1.503 | 1.875 | 1.108 |

TABLE 6

ESTIMATED NEW COMMUNITY AUTO OWNERSHIP

INCOME RANGE
(Thousands of Dollars)

| Persons Per Household | 0 -4 | 4 -7 | 7-10 | 10-15 | 15+ | No. of Cars | No. of Units | Avg.Cars Per Unit |
|---|---|---|---|---|---|---|---|---|
| 1 - 2 | 174 | 778 | 915 | 1520 | 1045 | 4432 | 4410 | 1.00 |
| 3 - 4 | 155 | 1660 | 2430 | 1350 | 714 | 6309 | 5040 | 1.25 |
| 5 or more | 300 | 1158 | 1295 | 592 | 254 | 3599 | 3150 | 1.14 |
| No. of Cars | 629 | 3596 | 4640 | 3462 | 2013 | 14340 | - | - |
| No. of Units | 1260 | 3780 | 3780 | 2520 | 1260 | - | 12600 | - |
| Avg. Cars Per Unit | 0.50 | 0.95 | 1.23 | 1.37 | 1.60 | - | - | 1.14 |

TABLE 7

TOTAL NEW COMMUNITY TRIP PRODUCTION

| Income Range | Average Auto Ownership (Table 6) | Person-Trips per Dwelling Unit per Day | Dwelling Units | Total Trips* |
|---|---|---|---|---|
| 0 - $4000 | 0.50 | 4.8** | 1260 | 6050 |
| 4 - 7000 | 0.95 | 7.3 | 3780 | 27600 |
| 7 - 10000 | 1.23 | 9.0 | 3780 | 34000 |
| 10 - 15000 | 1.37 | 9.5** | 2520 | 23900 |
| 15000 or over | 1.60 | 10.0** | 1260 | 12600 |
| TOTAL | | | | 104150 |

* excludes walking

**extrapolated or estimated

The eight modes (auto driver, etc.) are self-explanatory. We have shown all eight to preserve the organization used by Wilbur Smith. At the interpretive stage, however, some adjustments will be made, since not all modes (e.g. railroad) will be available to the New Community.

The nine trip purposes are finer divisions than those found in some other transportation studies. For example, two categories for shopping are included. Shopping - convenience refers to purchase of small everyday items -- groceries and drugs, for example. Shopping-GAF refers to larger items such as furniture or clothing. When this information is used in conjunction with information from other sources, the reader may find the two shopping categories combined.

Serve passenger, as Table 8 shows, is primarily an auto driver function. It includes such trips as driving someone to the train station or to

TABLE 8 - DAILY TRIPS BY PURPOSE AND MODE

| Purpose at Destination* | Auto Driver | | Auto Pass. | | Taxi Pass | | Truck Pass. | | School Bus | | Street Car or Subway | | Bus Pass. | | Train Pass. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. |
| Home | 34.8 | 20500 | 41.0 | 10400 | 46.3 | 435 | 24.2 | 25 | 47.5 | 2280 | 27.2 | 1585 | 54.5 | 4090 | 29.6 | 216 |
| Work | 22.6 | 13300 | 11.0 | 2780 | 17.3 | 162 | 46.6 | 48 | 0.3 | 14 | 41.9 | 2440 | 17.8 | 1335 | 57.4 | 419 |
| Personal Business | 8.6 | 5070 | 9.4 | 2380 | 14.6 | 137 | 9.6 | 10 | 0.5 | 24 | 6.8 | 396 | 4.4 | 330 | 2.1 | 15 |
| Recrtion | 1.6 | 940 | 7.8 | 1970 | 2.3 | 22 | 2.4 | 3 | 0.3 | 14 | 2.5 | 146 | 1.7 | 128 | 1.7 | 12 |
| School | 0.8 | 470 | 5.7 | 1440 | 4.3 | 40 | 6.6 | 7 | 50.7 | 2435 | 7.9 | 460 | 10.7 | 802 | 5.5 | 40 |
| Social | 6.4 | 3780 | 11.0 | 2780 | 8.6 | 81 | 3.7 | 4 | 0.6 | 29 | 3.3 | 192 | 4.2 | 315 | 0.6 | 4 |
| Shopping-Conven. | 8.2 | 4840 | 7.6 | 1920 | 3.3 | 31 | 3.3 | 3 | 0.0 | - | 1.7 | 99 | 3.0 | 225 | 1.3 | 10 |
| Shopping-G.A.F. | 4.2 | 2480 | 6.0 | 1520 | 3.2 | 30 | 3.1 | 3 | 0.0 | - | 8.7 | 507 | 3.7 | 277 | 1.9 | 14 |
| Serve Passenger | 12.8 | 7550 | 0.5 | 125 | 0.1 | 1 | 0.5 | 1 | 0.1 | 5 | 0.0 | - | 0.0 | - | 0.0 | - |
| TOTAL | 100.0 | 58930 | 100.0 | 25315 | 100.0 | 939 | 100.0 | 104 | 100.0 | 4801 | 100.0 | 5825 | 100.0 | 7502 | 100.1 | 730 |

*Excludes Change in Mode.

the store. Because we could not find in other sources more information on this type of trip, the serve passenger category will be excluded in later tables.

### 3.2.2.4 Consideration of Home Trips

Table 8 lists home as a trip purpose. This is a potential source of confusion because other studies, as well as other tables in the Wilbur Smith report itself, exclude home as an explicit trip purpose.

For this reason we replace Table 8 by Table 9, in which the home trips have been distributed among the seven other trip purposes (serve passenger excluded). For example, the category of work trips in Table 9 includes (1) trips from home to work; (2) trips from other origins to work; and (3) trips from work to home. Trips of types (1) and (3) are referred to as "home based work trips."

Because some errors have been incurred in the distribution of home trips among the other categories, totals may not agree with predictions derived by other means (e.g. Table 10). These errors do not affect our results significantly.

For the remainder of this report, stratifications by trip purpose will not include home as an explicit destination.

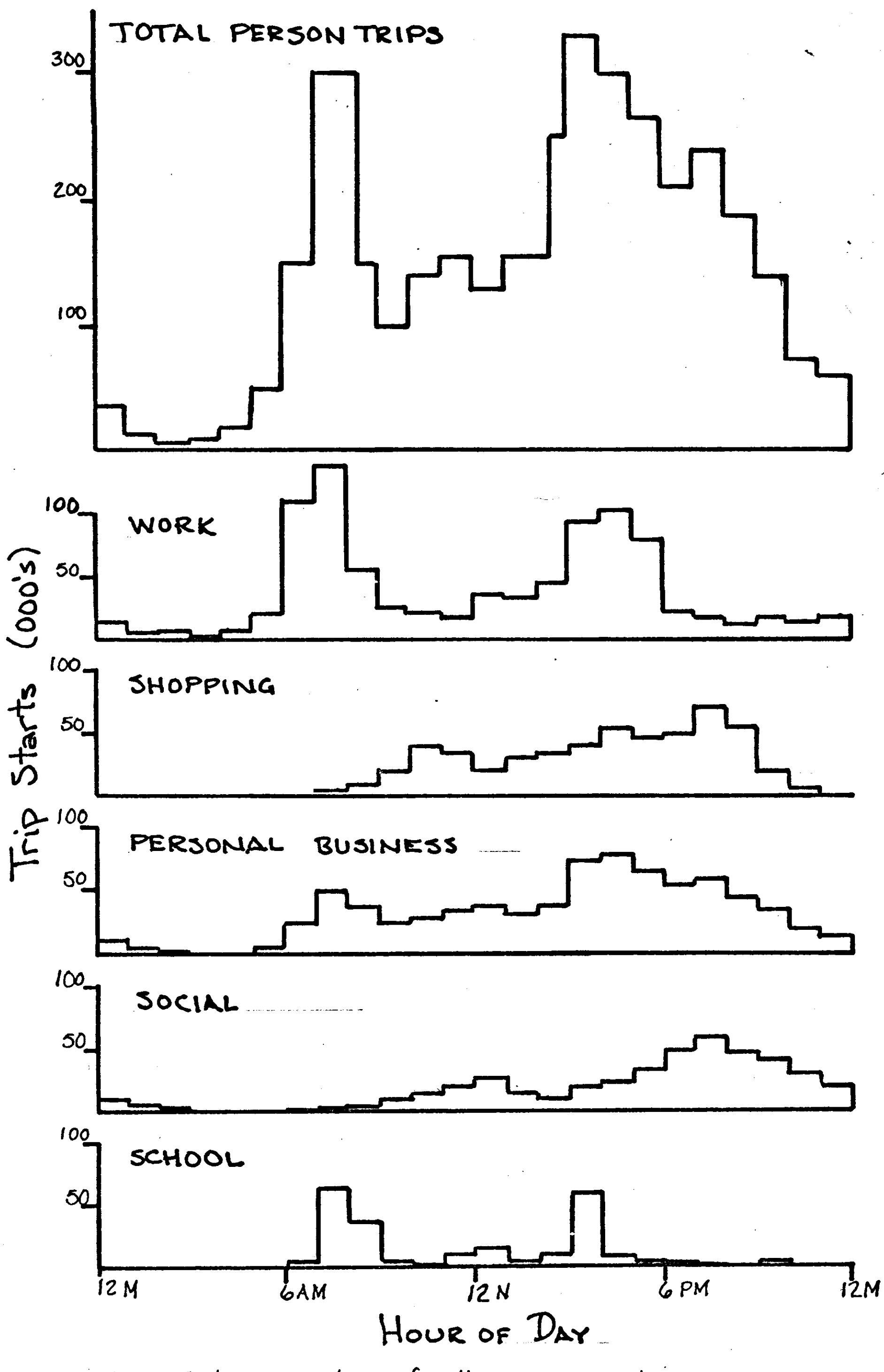
### 3.2.2.5 Time of Day

We obtained information on hourly volume of trips for different modes from a report published by Stanford Research Institute (14). This information is shown in Figure 8. Although these graphs do not apply to the

TABLE 9 - DAILY TRIPS BY PURPOSE AND MODE

(Adjusted for Home Trips)

| Purpose | Auto Driver | Auto Pass. | Taxi | Truck | School Bus | Subway | Bus | Train |
|---|---|---|---|---|---|---|---|---|
| Work | 21400 | 4470 | 261 | 77 | 23 | 3930 | 2150 | 674 |
| Personal | 7530 | 3530 | 203 | 15 | 36 | 588 | 490 | 22 |
| Shopping (Convenience) | 7820 | 3100 | 50 | 5 | - | 160 | 363 | 16 |
| Shopping G.A.F. | 3900 | 2390 | 47 | 5 | - | 797 | 436 | 22 |
| Social | 6250 | 4600 | 134 | 7 | 48 | 318 | 521 | 7 |
| Recreation | 1547 | 3240 | 36 | 5 | 23 | 240 | 211 | 20 |
| School | 877 | 2690 | 75 | 13 | 4540 | 858 | 1497 | 75 |




Note: Daily person trips for all purposes equals 3,500,000.

Source: Reference 14

FIGURE 8. DISTRIBUTION OF PERSON-TRIPS, BY HOUR OF DAY

Boston region, Schuster and Michael (27) have shown that hourly distrubutions of total trips, taken from different cities, tend to agree closely. We therefore feel justified in using the data in Figure 8.

3.2.2.6 Trip Predictions

From the information in the previous sections we have developed a preliminary plan of New Community travel desires.

Figures 9 and 10 show projected hourly New Community usage of four transportation modes. These figures include trips made to and from work, shopping, and school, as well as personal, social, and recreational trips. The data from which these figures are drawn are given in Tables 16 - 19 in the Appendix.

Figures 9 and 10 show that:

(1) We can expect heavy automobile usage during the evening hours, at which time the trips home from work and shopping are superimposed on evening shopping, social, and recreational trips. During the peak hour we expect 4800 automobile-driver trips. (This figure does not include automobile-passenger trips.)

(2) School bus trips are peaked during the 6:00 - 9:00 A.M. and 3:00 - 5:00 P.M. periods, with a minor peak at noon. During the maximum hour schoolbuses transport about 1200 students.

(3) The transit system also can expect the two characteristic rush-hour peaks. We project a peak-hour rail transit demand of 900 persons and a peak-hour bus transit demand of 780 persons.

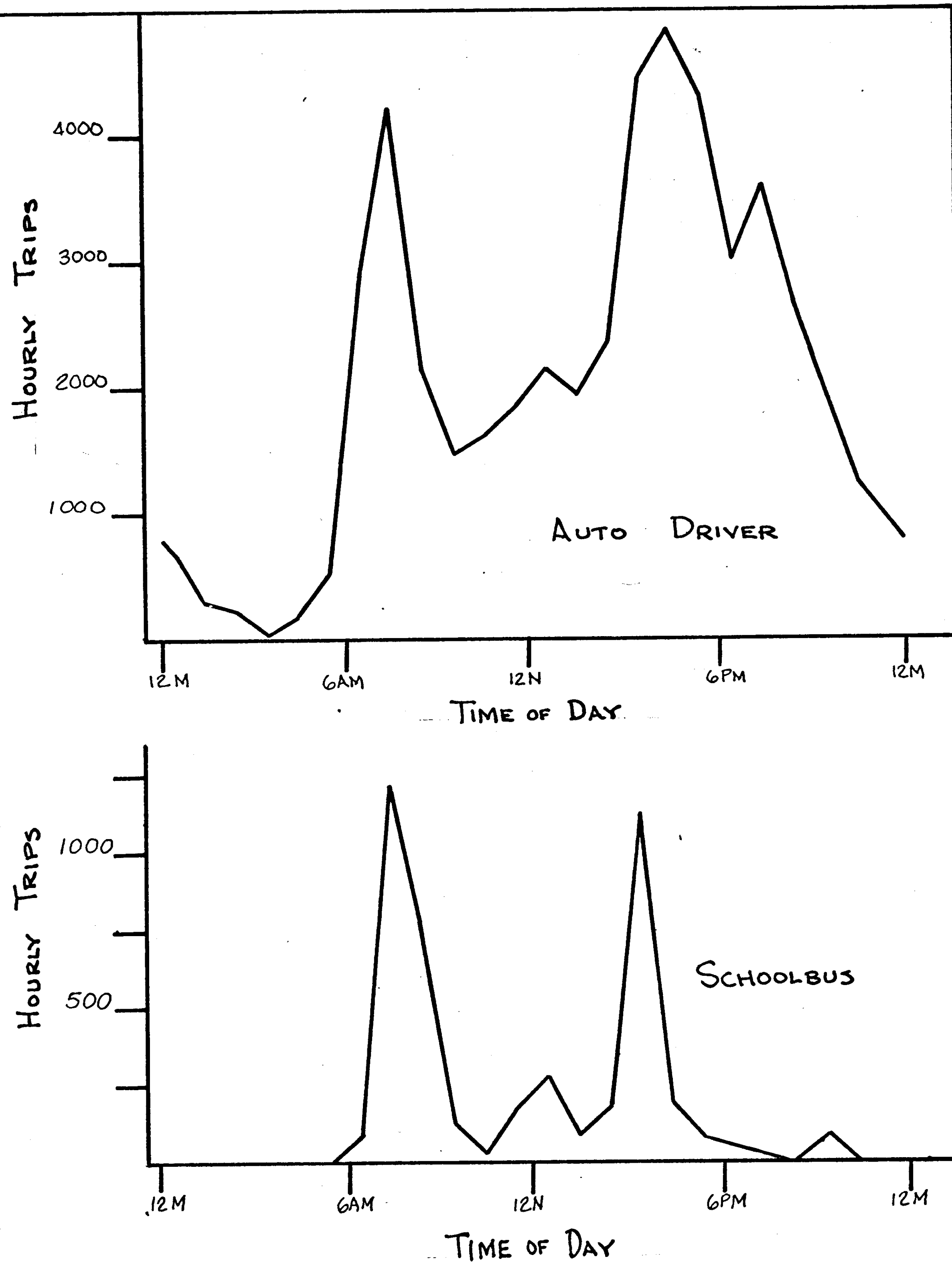



FIGURE 9. HOURLY DISTRIBUTION OF AUTO DRIVER TRIPS AND SCHOOLBUS TRIPS

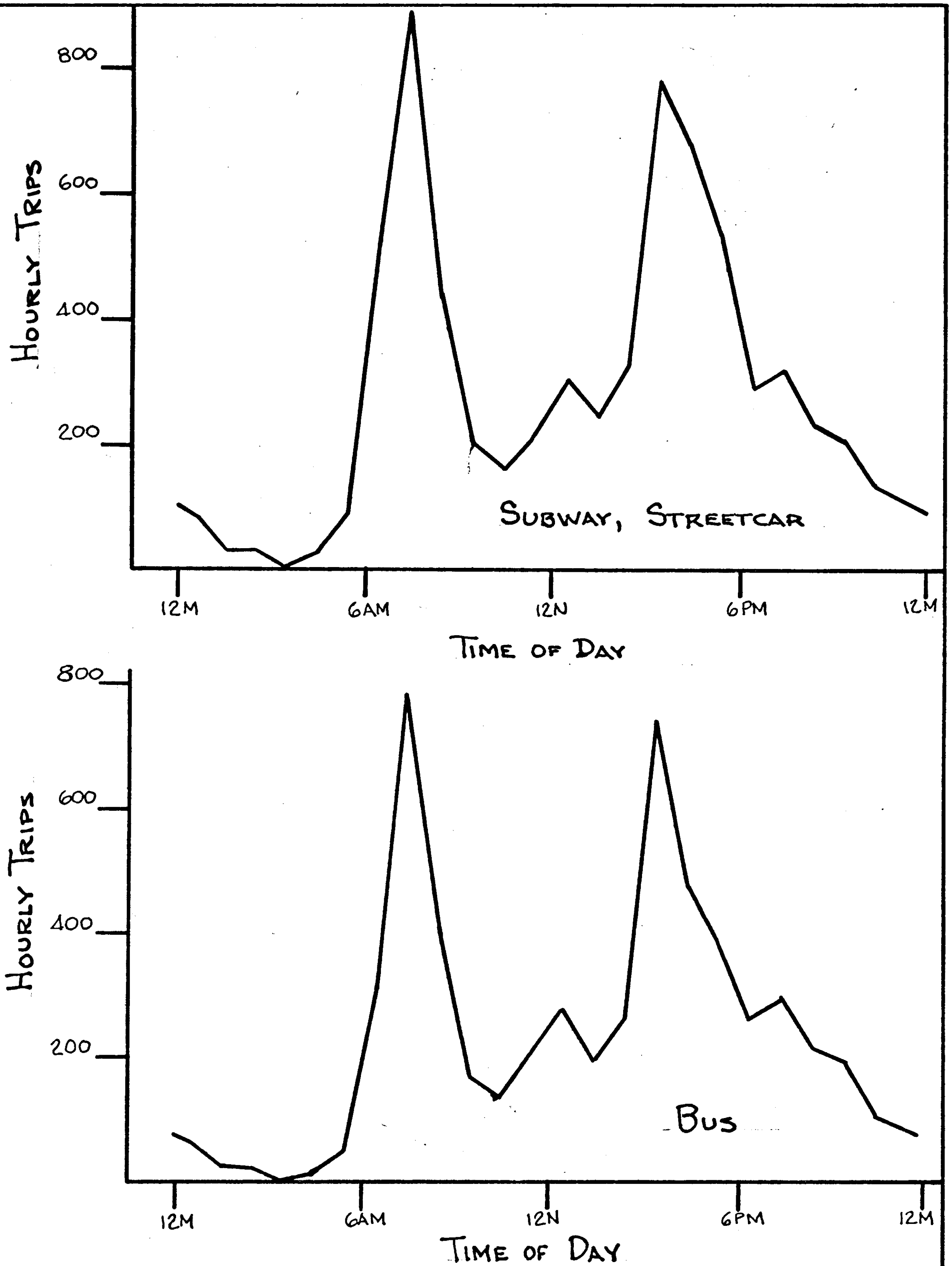



FIGURE 10. HOURLY DISTRIBUTION OF TRANSIT TRIPS

Since we have not yet stipulated a particular transit system for the New Community, it would be fairer to combine these two demands. We then project a peak demand for transit of 1680 persons per hour.

3.2.3 Attractive and Generative Nodes

It remains to determine the geographical origins and destinations (i.e., the nodes) of the trips represented by Figures 9 and 10. In the following sections we will list our assumptions concerning the locations and importance of these nodes. In Section 3.2.4 we will apply these assumptions to our previous work to obtain a detailed origin-destination estimate.

We recognize two distinct areas of New Community trip production and attraction. The first is the mainland -- Boston, Columbia Point, and the South Shore. The volume of traffic to or from the mainland will determine the required sizes of links between the islands and shore, as well as the added burden placed upon the mainland system.

The second concentration of nodes is the New Community itself. The volume of internal traffic will determine the required size of the island circulation system. This system will, in turn, influence (as well as be influenced by) the arrangement of land use zones within the New Community; the level of technology or sophistication to be embodied in the transportation planning; and New Community policies regarding vehicle restrictions, right-of-way restrictions, licensing, ownership, and so on.

### 3.2.3.1 Mainland Nodes

Conclusions drawn in Section 3.1.1.3 indicate the dependence of the New Community on mainland services and facilities, including places of employment, shopping centers, and recreation and eating places.

At this time we cannot predict accurately the New Community's impact on Boston and the South Shore area. Following is a list of assumptions we have made for transportation purposes. (These sections make use of information in Table 10; source: Wilbur Smith.)

TABLE 10

DISTRIBUTION OF TRIPS BY TRIP PURPOSE

| Purpose at Destination* | Per Cent of Total Trips (Observed in Study Area) | Projected Number of New Community Trips |
|---|---|---|
| Work | 31.0 | 32,300 |
| Personal Business | 11.9 | 12,400 |
| Recreation | 5.2 | 5,400 |
| School | 9.8 | 10,200 |
| Social | 11.8 | 12,300 |
| Shopping-Convenience | 11.6 | 12,100 |
| Shopping -, GAF | 7.3 | 7,600 |
| Serve Passenger | 11.4 | 11,900 |
| TOTAL | 100.0 | 104,200 |

*excludes change of mode.

#### 3.2.3.1.1 Work Trips

Our estimate of total daily person-trips to work (Table 10) is 32,300. This figure corresponds to a work force of about 16,000 (which agrees closely with the 17,000 estimate provided by the Boston Redevelopment Authority).

We assume that 26,000 of these trips will be linked to the mainland. Forty per cent of these 26,000 mainland trips will have origin or destination to the north (in general, toward Boston), and 40 per cent to the south (in general, toward Routes 3 or 128), and 20 per cent (5200) to Columbia Point. The remaining 6,300 work trips will have both origin and destination on the New Community islands. (These estimates do not include outside residents who work within the Community.)

3.2.3.1.2 Personal Business Trips

Personal business trips have a strong "neighborhood" connotation; e.g. going to church or visiting the family doctor or dentist. Figures 6 and 7 show that, in reality, these trips are generally two to three miles long, or of five to fifteen minutes' duration. Seeing no reason to change this aspect of travel, we assume that only 20% of all personal business trips will be linked with the mainland. Using Table 10, we compute a daily total of 2480 personal business trips. Seventy per cent of these, or 1736, will come from or go to the South Shore; the remaining 744 will come from or go to Boston.

3.2.3.1.3 Shopping Trips

We anticipate that shopping facilities located on the Islands will be intended for Community use alone; no regional centers are planned. This assumption implies that some purchases by New Community residents, particularly of items like furniture, lumber and building supplies, expensive clothing, automobiles, and appliances, will necessarily be made in mainland stores. The shopping-GAF category in Table 10 includes items such as the above. We therefore assume that most of the shopping-GAF trips, or about 35% of total shopping trips (equals 6900 person-trips) will be linked with the mainland. We further assume that 50 per cent of these mainland trips (equals 3450) will be northward toward Boston, and 50% southward, toward Quincy and Braintree.

3.2.3.1.4 <u>Social-Recreation Trips</u>

We project a daily total of 5400 recreational person-trips and 12,300 social person-trips for the New Community (Table 10). It is unknown what percentage of these trips will require connections to the mainland. The controlling factors will be (1) the density of friends and relatives residents find in the New Community; (2) the type of recreational facilities located on the Islands; and (3) the extent to which these facilities can compete with the downtown and Shoth Shore theatres and restaurants.

For now, we make the arbitrary assumption that 30 percent of the combined social-recreational trips (5310) will be linked with Boston, 30 per cent with the South Shore (Routes 123, 3, 3A), and 40 per cent (7080) will remain on the Community islands.

3.2.3.1.5 <u>School Trips</u>

Table 11 gives the estimated distribution of school age children in the New Community.

The school age population of about 14,000 indicates a maximum of 28,000 daily trips to or from school. However, we predict in Table 10 only 10,200 school trips. The difference is explained by (1) walking trips, which are not included in our 10,200 estimate; and (2) boarding at out-of-town schools by some high school and college students.

TABLE II

AGE DISTRIBUTION OF NEW COMMUNITY SCHOOL AGE POPULATION

| Age | | Number of Children | Grade |
|---|---|---|---|
| 5 - 11 | | 634 | Elementary |
| 12 - 14 | | 2646 | Junior High |
| 15 - 18 | | 2880 | High School |
| 19 - 21 | | 2250 | College |
| | TOTALS | 14210 | |

We envision at least two junior high schools and one high school serving the New Community. Elementary schools will be located on the separate islands, presumably within walking distance of most pupils.

The only school trips requiring connections to the mainland will therefore be those of college students either attending the Columbia Point campus of the University of Massachusetts, or commuting to a school downtown. Of the anticipated 2250 New Community college students, we assume that 50 per cent or 1125, will commute downtown, and 25 per cent, or 563, will attend the University of Massachusetts. The remaining 562 students will live away from home during the school year and do not enter into our calculations.

3.2.3.1.6 Summary

In the preceding sections we have hypothesized three mainland centers of trip attraction and generation: the City of Boston, Columbia Point, and the South Shore area traversed by Routes 3, 3A, and 128. We assume the following number of daily trips between these centers and the New Community:

TABLE 12

DAILY TRIPS BETWEEN NEW COMMUNITY AND MAINLAND CENTERS

| Trip Purpose | Mainland Centers | | |
|---|---|---|---|
| | Boston | Columbia Point | South Shore |
| Work | 10400 | 5200 | 10400 |
| Personal Business | 744 | - | 1736 |
| Shopping | 3450 | - | 3450 |
| Social-Recreation | 5310 | - | 5310 |
| School | 2250 | 1126 | - |

3.2.3.2 Internal Nodes

Internal trips have both origin and destination on one of the New Community islands. The volume of the internal traffic can be computed from the assumptions of the preceding sections.

3.2.3.2.1 Internal Work Trips

A labor force of about 3000 people will make 6300 daily work trips, or 20 per cent of the daily total, to or from places of employment on the New Community islands. These employment areas include shopping centers, government and private offices, schools, transportation facilities, plus any light industries which may locate in the Harbor.

3.2.3.2.2 Internal Personal Business Trips

As indicated earlier, personal business trips are likely to be short. We therefore assume that 80 per cent of all these trips, or 9920 daily, will remain within the island cordon.

3.2.3.2.3 Internal Shopping Trips

Sixty-five per cent of all daily shopping trips, or about 12,800, will be linked with the new island facilities. We expect that most purchases made on these trips will be of everyday items such as food or drugs.

3.2.3.2.4 Internal Social-Recreation Trips

We arbitrarily assume that 40 per cent of all social-recreation trips, or 7080 daily, will be internal. This figure does not take into account any regional amusement attraction that might be built on one of the islands.

3.2.3.2.5 Internal School Trips

A sufficient number of schoolrooms will be built on the islands to serve all New Community elementary and secondary school students. Since the islands themselves are no longer than a mile or two in extent, presumably a significant fraction of the students could walk to school.

Based on a preliminary plan of several neighborhood elementary schools, two junior high schools, and one high school, we make the following estimates using the information in Table II:

(1) Most of the 6434 elementary school pupils will walk to and from school. These trips are not included in our calculations.

(2) About one-half of the 2646 junior high school students and

about three-quarters of the 2880 high school students will ride to school by schoolbus, automobile, or transit.

We therefore predict about 2646 daily trips to or from junior high school, and about 4200 daily trips to or from high school.

### 3.2.3.2.6 New Community Land Use Arrangement

A discussion of internal origins and destinations is not complete without some mention of the proposed New Community land use arrangement. As pointed out in Section 3.1.1.2, a good land use pattern promotes transportation efficiency and contributes to the satisfaction and convenience of users.

Figure 11 illustrates Land Use Plan I, currently in use on the New Community Project. It is characterized by mixed density residential areas on all of the islands and a commercial/civic center on the southeastern tip of Thompson Island. Major shopping centers, government offices, manufacturing and business concerns, utilities buildings, and hospitals are concentrated in this commercial/civic center.

Figure 12 illustrates Land Use Plan II. It is identical to Plan I with the exception that the commercial/civic center has been relocated along the southern edge of Spectacle Island.

Figure 13 illustrates Land Use Plan III, in which there is no concentrated commercial/civic center. The associated facilities, particularly shopping and employment, are distributed among the three islands and Columbia Point.

Plans I-III define the nodes of trip attraction and generation within the New Community.

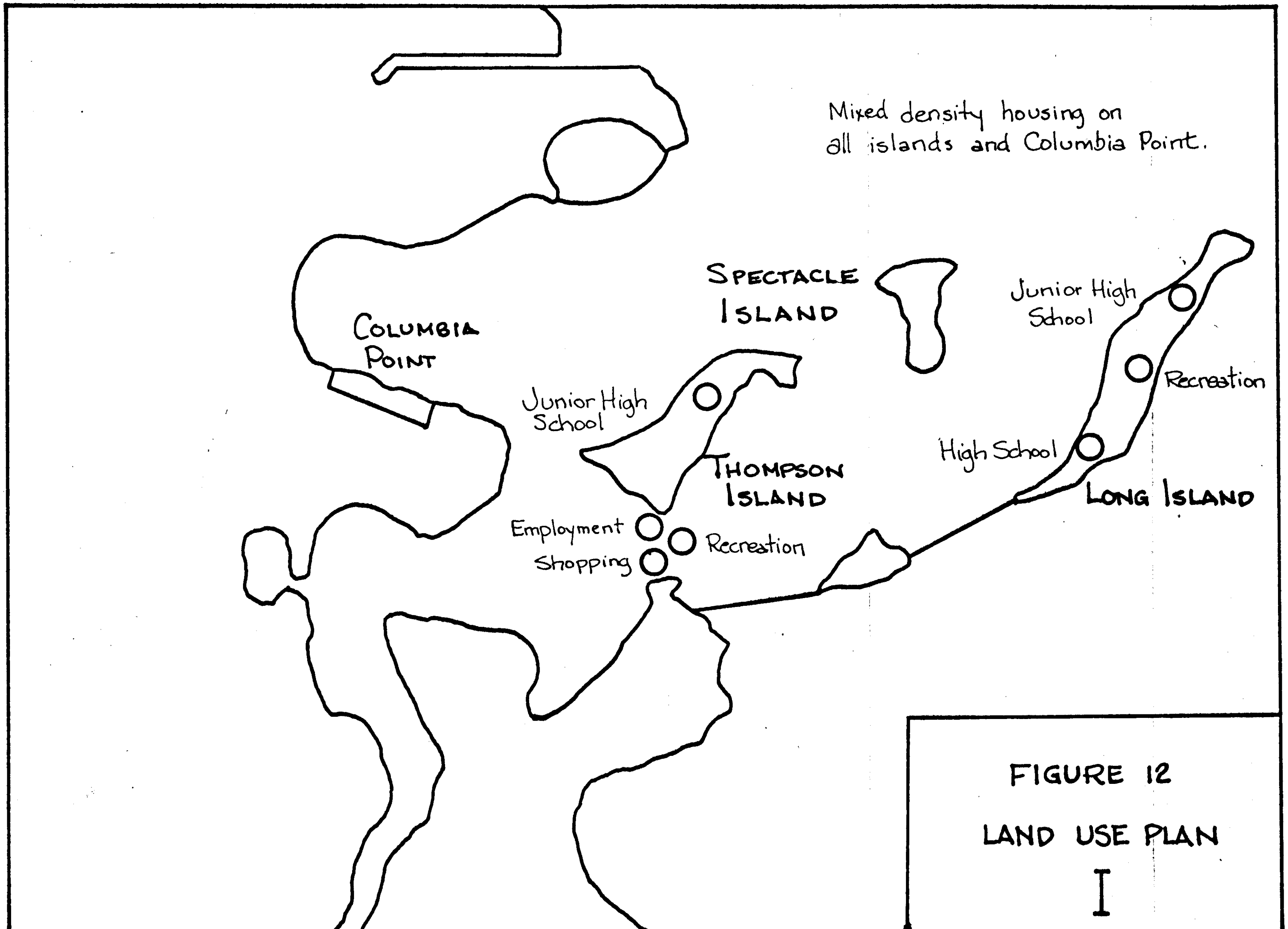



FIGURE 12

LAND USE PLAN

I

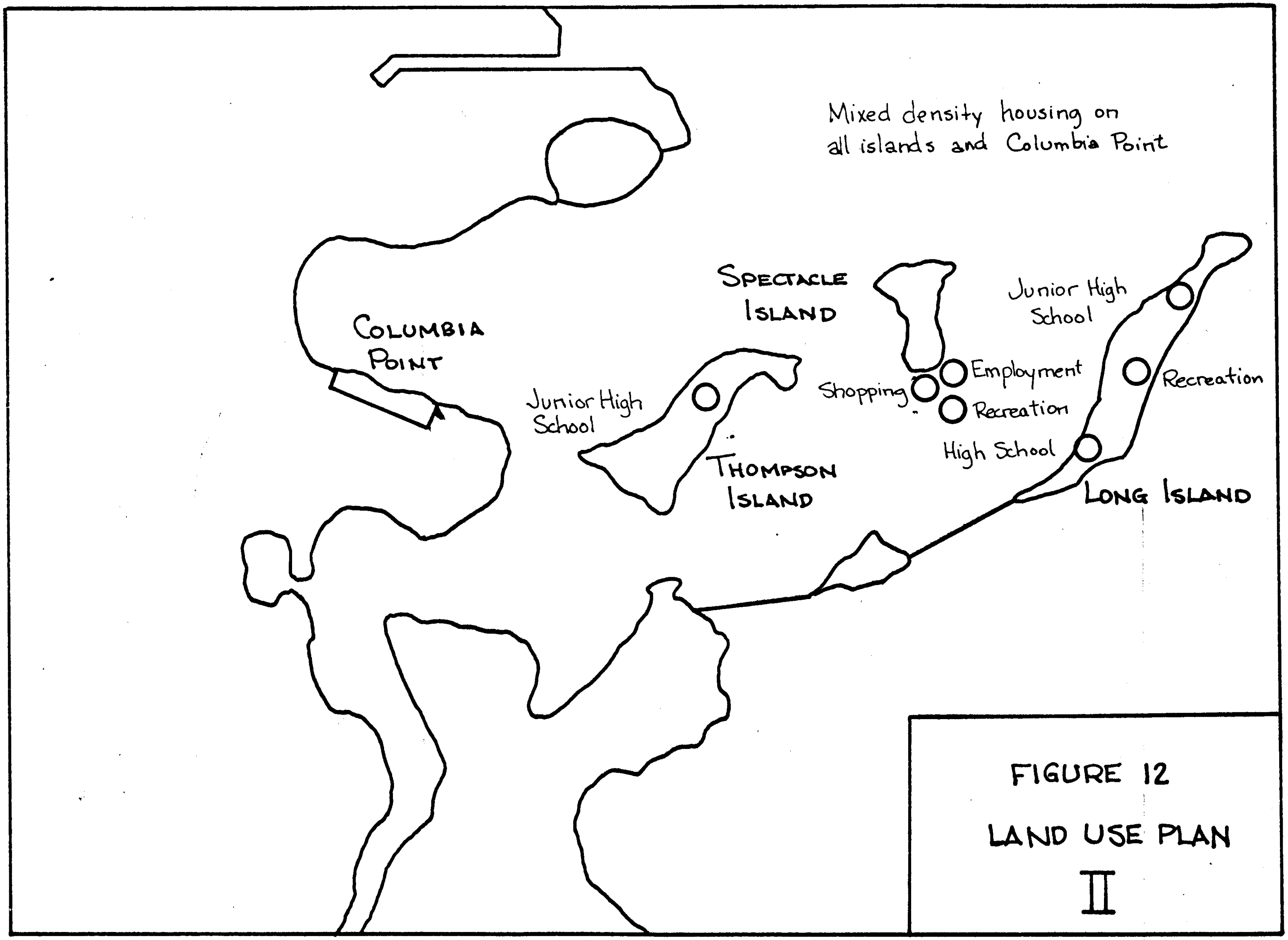



FIGURE 12

LAND USE PLAN

II

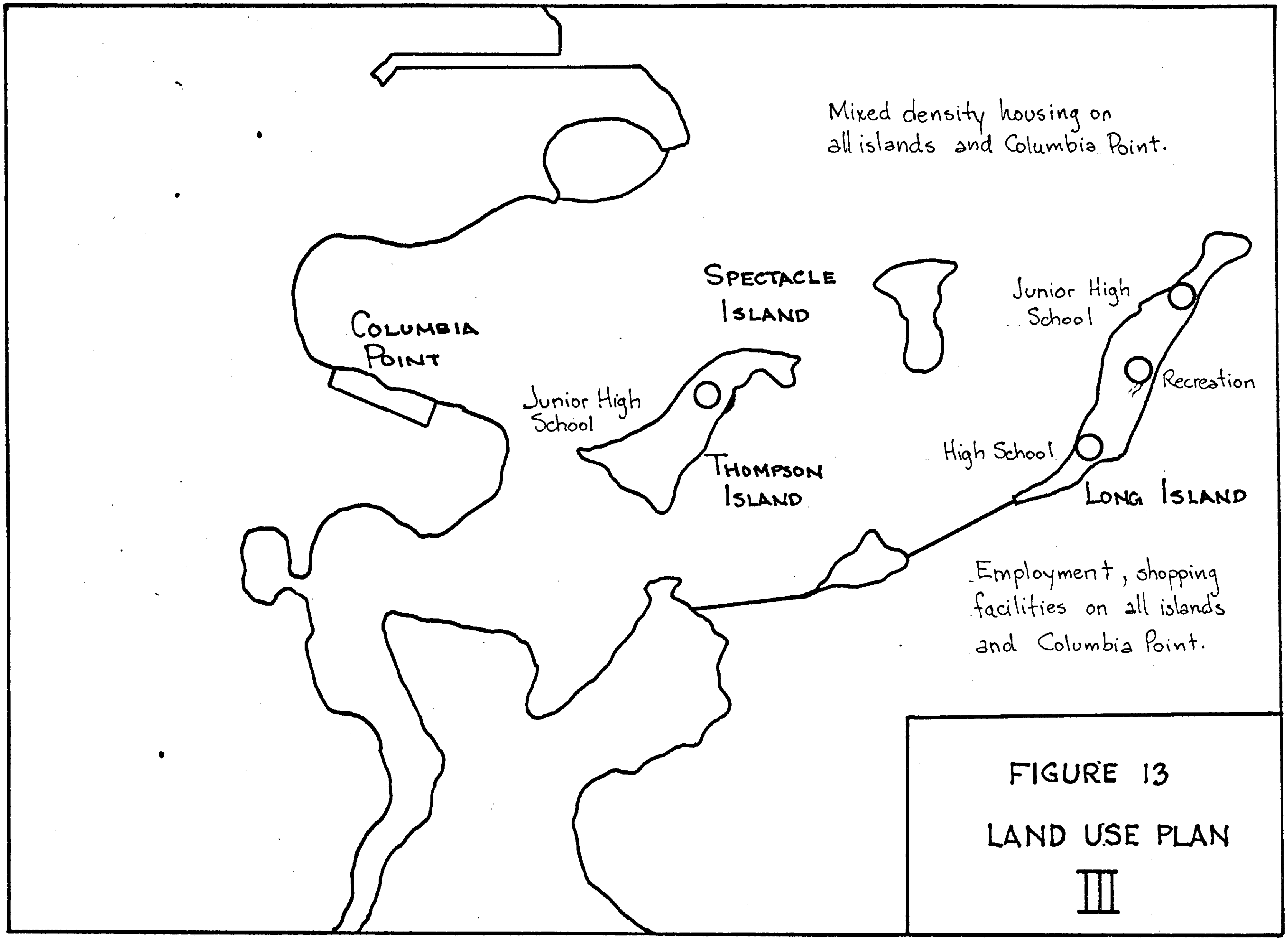



FIGURE 13

LAND USE PLAN

III

3.2.3.2.7 Summary

Table 13 represents our complete estimate of New Community trip production and attraction. The island nodes have been listed functionally (school, community center, etc.) rather than geographically (Thompson Island, etc.) to allow use of the statistics in all three Community plans.

3.2.3.3 Home Based Trips

As pointed out in Section 3.2.2.4, each entry in Table 13 represents three types of trips: (1) trips from home to destination; (2) trips from origins other than home to destination; and (3) trips from the above desitnations back to home. Types (1) and (3) are home based trips. Segregation of home based trips in an origin-destination study is probably unnecessary for trips linked with the mainland. As long as people travel from the "general area" of the New Community to mainland destinations, the fact that they have made an intermediate stop on the way (thus terminating the home based portion of the trip) does not affect the predicted impact of the New Community traffic on the mainland system.

On the other hand, an origin-destination study of travel among the islands themselves requires knowledge of both the percentage of home based trips and the locations of these homes.

From Wilbur Smith (30) we know that home based trips account for about 75 per cent of total trips for each purpose. However, we do not know at what hour of the day the other 25 per cent of the trips occur, or what nodes they link (e.g. personal business to work, or work to shopping).

For design purposes we make four assumptions, concentrating on peak hour traffic. We assume that:

TABLE 13 - NEW COMMUNITY TRIP ORIGINS AND DESTINATIONS

| Trip Purpose | ORIGIN OR DESTINATION: Boston | South Shore | Columbia Point | New Comm'ty Center | Private Homes, etc. | Rec-reation Spots | Junior High School | High School |
|---|---|---|---|---|---|---|---|---|
| Work | 10400 | 10400 | 5200 | 6000 | - | - | 125 | 175 |
| Personal Business | 744 | 1736 | - | - | 9920 | - | - | - |
| Shopping | 3450 | 3450 | - | 12800 | - | - | - | - |
| Social-Recreation | 5310 | 5310 | - | - | - | 7080 | - | - |
| School | 2250 | - | 1126 | - | - | - | 2646 | 4200 |

(1) Most morning peak hour traffic is home based (originating from home);

(2) Many non-home based trips occur during lunch hours and do not affect our calculations;

(3) Most evening peak hour work trips and school trips are home based (destined toward home);

(4) A significant, but unknown, fraction of the evening peak hour personal business, shopping, and social-recreation trips are not home based, but originate from work, school, or other shopping social, and personal business engagements.

If assumption (4) is correct, our figures represent "double counting" of personal business, shopping, and social-recreation trips during the evening rush hours. For example, a man on the way home from work buys some groceries at a store; his trip is considered a shopping trip (non-home based). He then proceeds home, and we credit him with a second shopping trip (home based). Because the two trips do not converge on the same destination, this double tally tends to exaggerate the traffic volume of the personal business, shopping, and social-recreation trips. It also tends to diminish the number of work and school trips headed toward home. What we must remember is that a large number of, say, shopping trips during the 3P.M. - 4 P.M. rush hour does not indicate convergence of a large crowd at the shopping center; rather, it indicates a large number of trips ending or beginning at the shopping center.

Since we have no firmer information on this subject, we assume that about 50 per cent of the personal business, shopping, and social-recreation trips during the evening rush hours are home based.

### 3.2.4 Prediction of New Community Travel Desires

We conclude this phase of the study by combining our assumptions of attractive and generative nodes with our earlier trip predictions (Section 3.2.2.6). The results will be the projected desire lines of travel.

Using Table 9 and Figure 8, we have made a detailed breakdown of all New Community trips as a function of trip purpose, mode, and hour of day. Because the results are lengthy, they appear in the Appendix as Tables 20 - 24.

We have taken these total hourly trips and further distributed them by island of residence of the traveler. Results are listed in Tables 25 - 28 in the Appendix. The entries appearing in Tables 25 - 28 are _not_ the trips headed to or away from a particular island; rather, they are _all_ trips taken throughout the day by inhabitants of that island. (If we were considering home based trips alone, the numbers then _would_ indicate trips to or from a particular island.)

Using the information in Table 13 and Tables 25 - 28 , we have prepared Figures 14 - 21. These figures show projected traffic volumes between pairs of nodes for the auto driver, subway, and bus modes, during the peak hours of 7 to 8 A.M. and 3 to 4 P.M. Figures 14 - 21 represent the results of our origin-destination studies, and will be used later for design purposes.

(Because Figures 14 - 21 include the commercial/civic center as an explicit node, they are directly applicable to Land Use Plans I and II. For Land Use Plan III, in which there is no major center, all trips shown in Figures 14 - 21 as linking with the center will be distributed among the three islands and Columbia Point.)

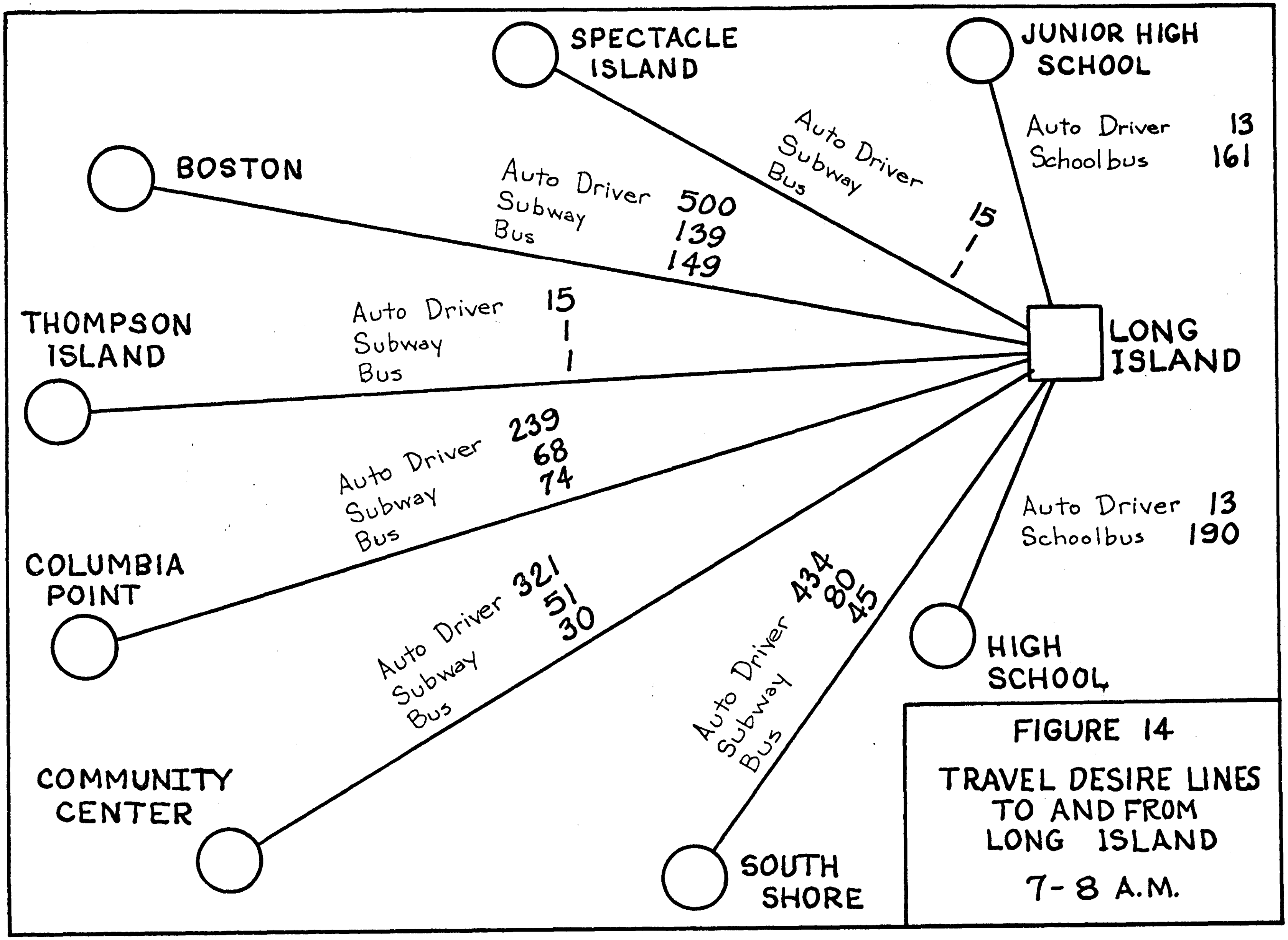



FIGURE 14
TRAVEL DESIRE LINES TO AND FROM LONG ISLAND
7-8 A.M.

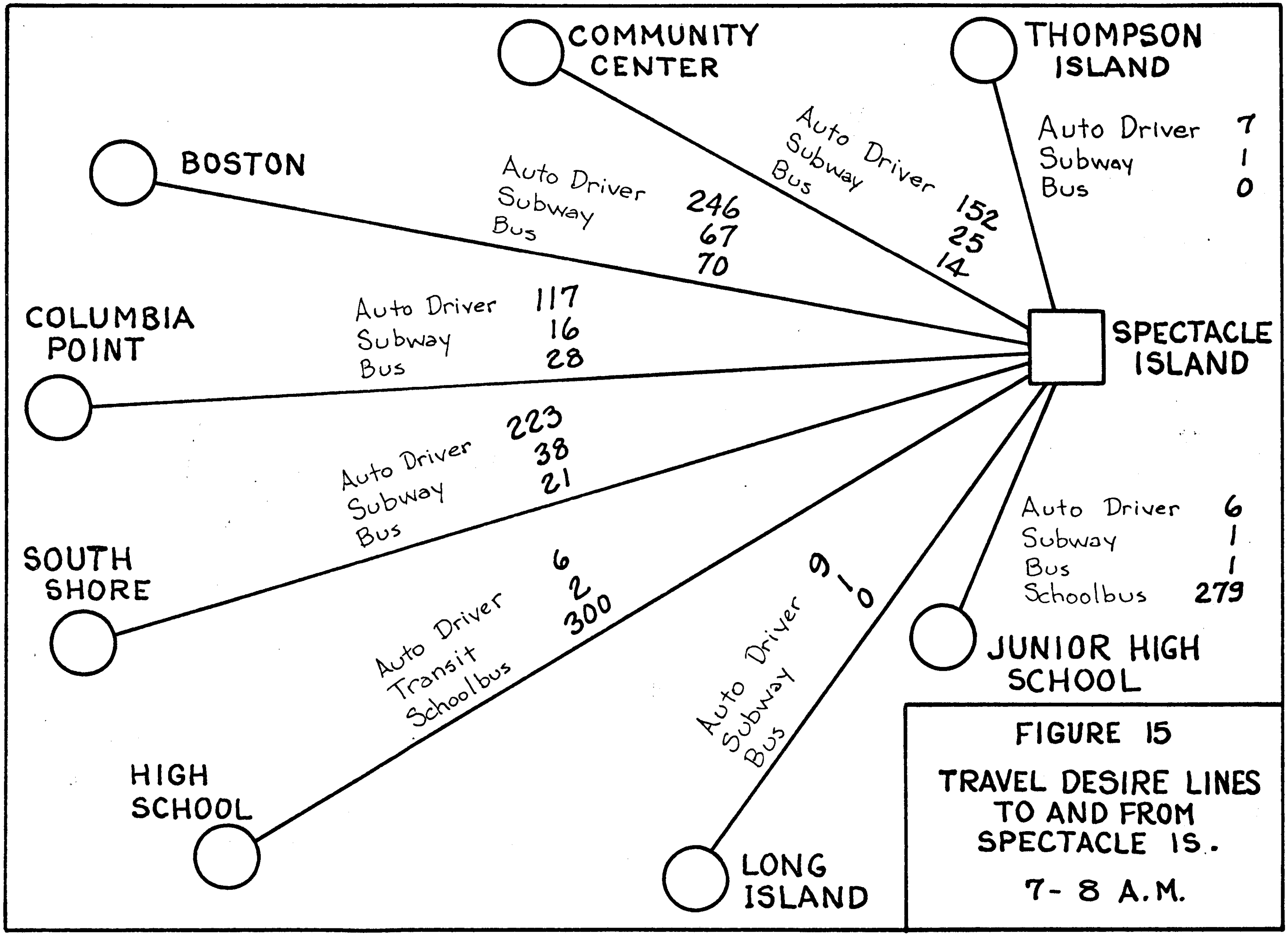



FIGURE 15

TRAVEL DESIRE LINES TO AND FROM SPECTACLE IS.

7- 8 A.M.

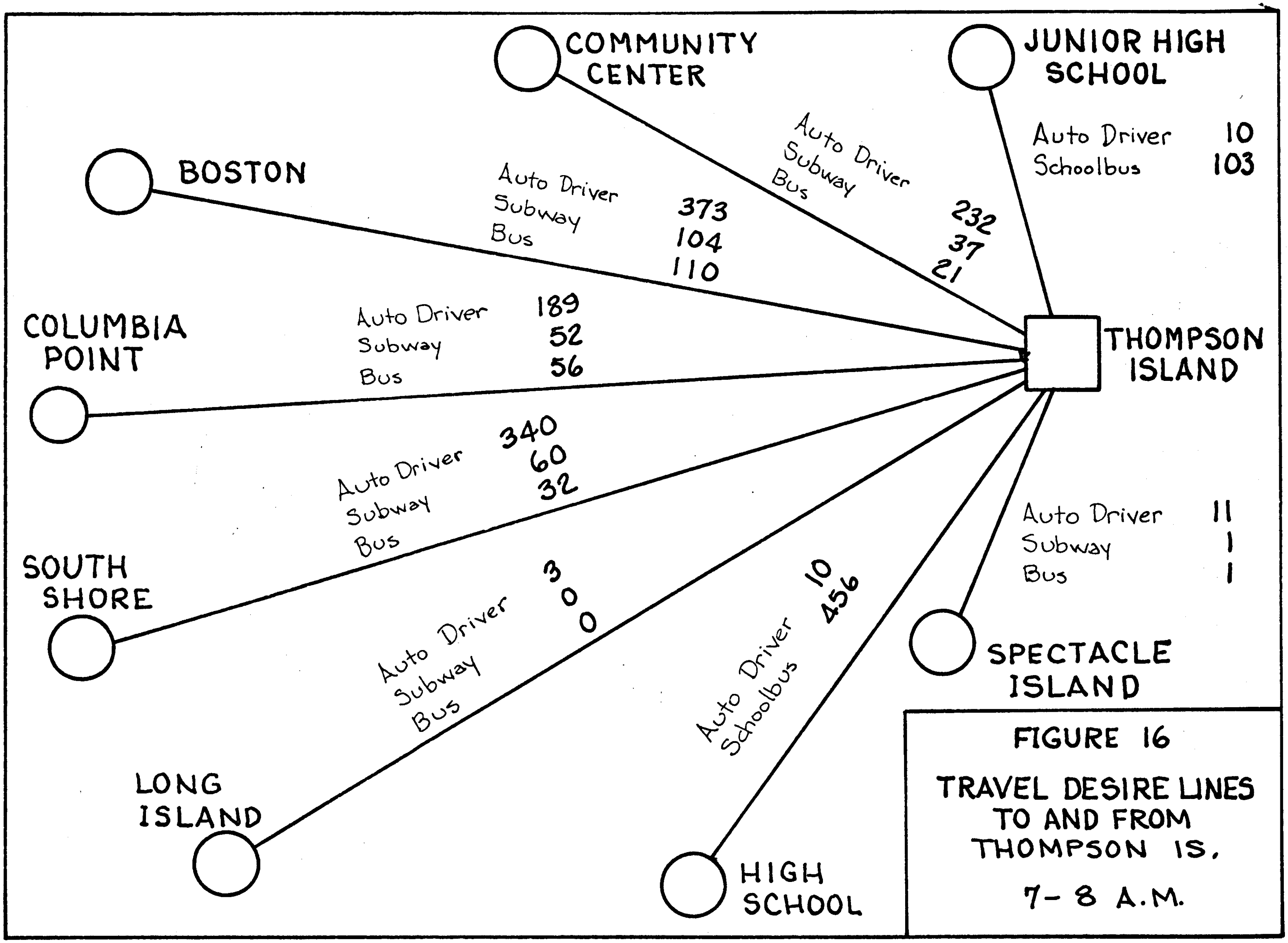



FIGURE 16

TRAVEL DESIRE LINES TO AND FROM THOMPSON IS.

7- 8 A.M.

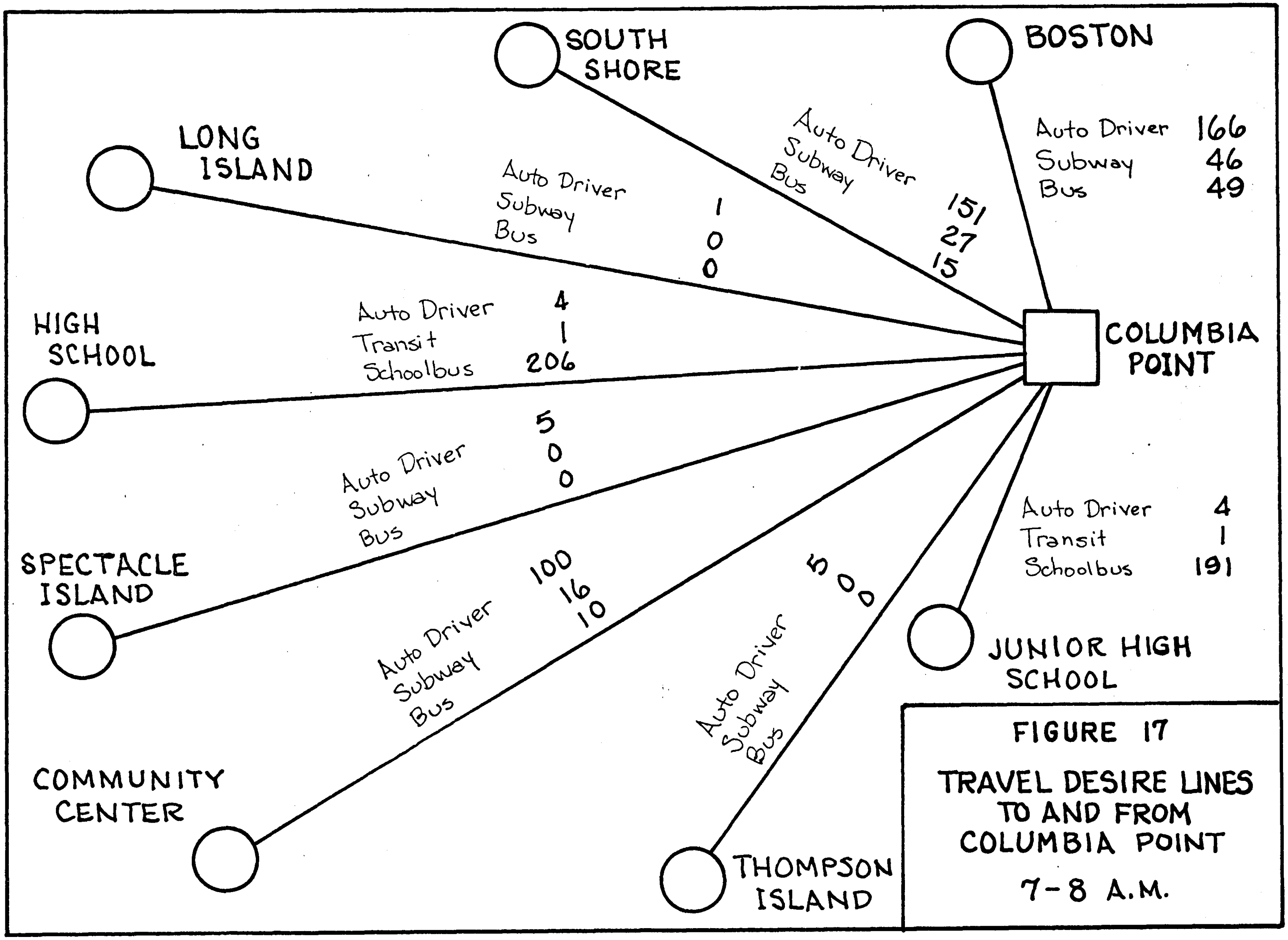



FIGURE 17

TRAVEL DESIRE LINES TO AND FROM COLUMBIA POINT

7-8 A.M.

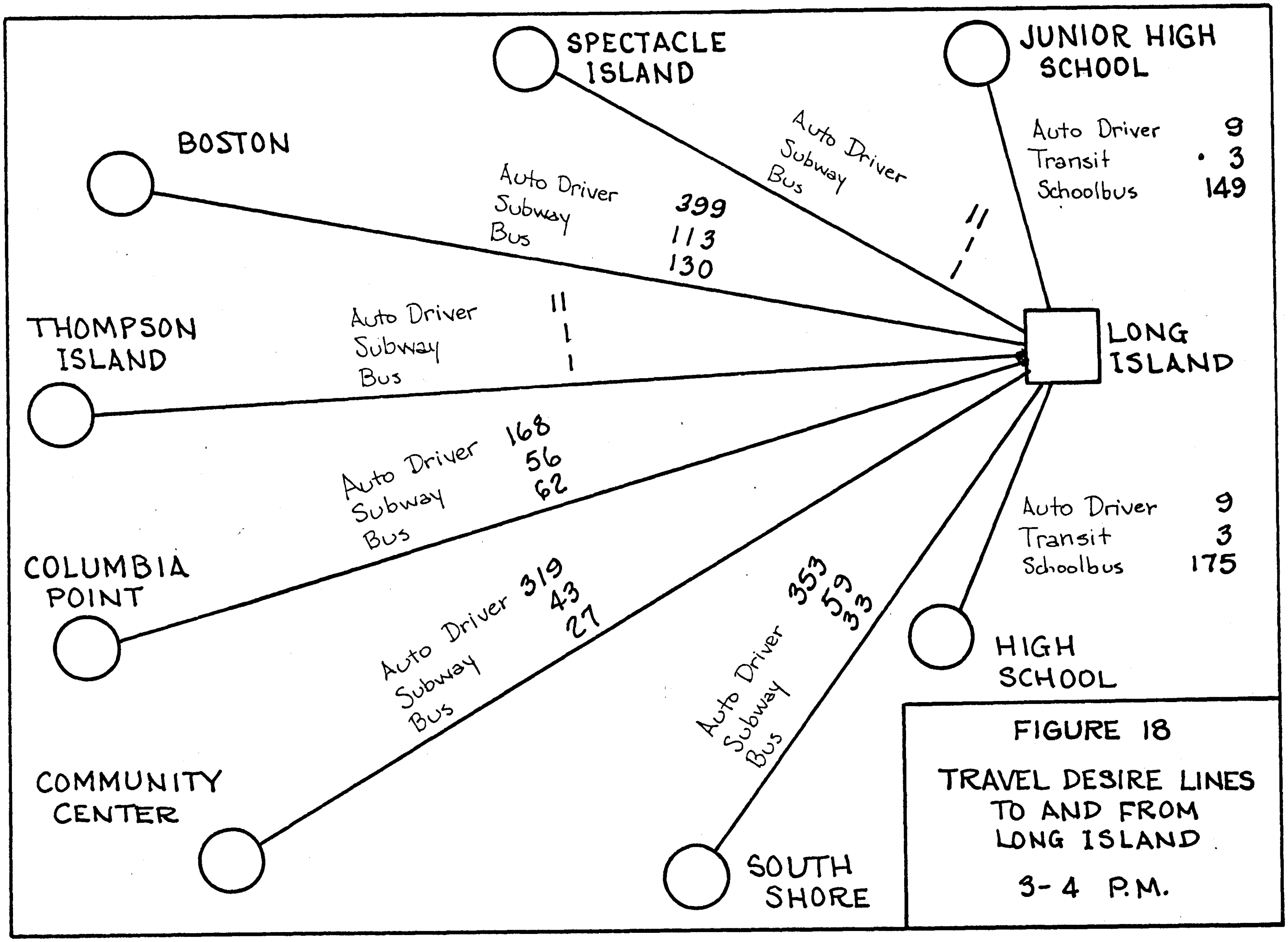



FIGURE 18

TRAVEL DESIRE LINES TO AND FROM LONG ISLAND

3-4 P.M.

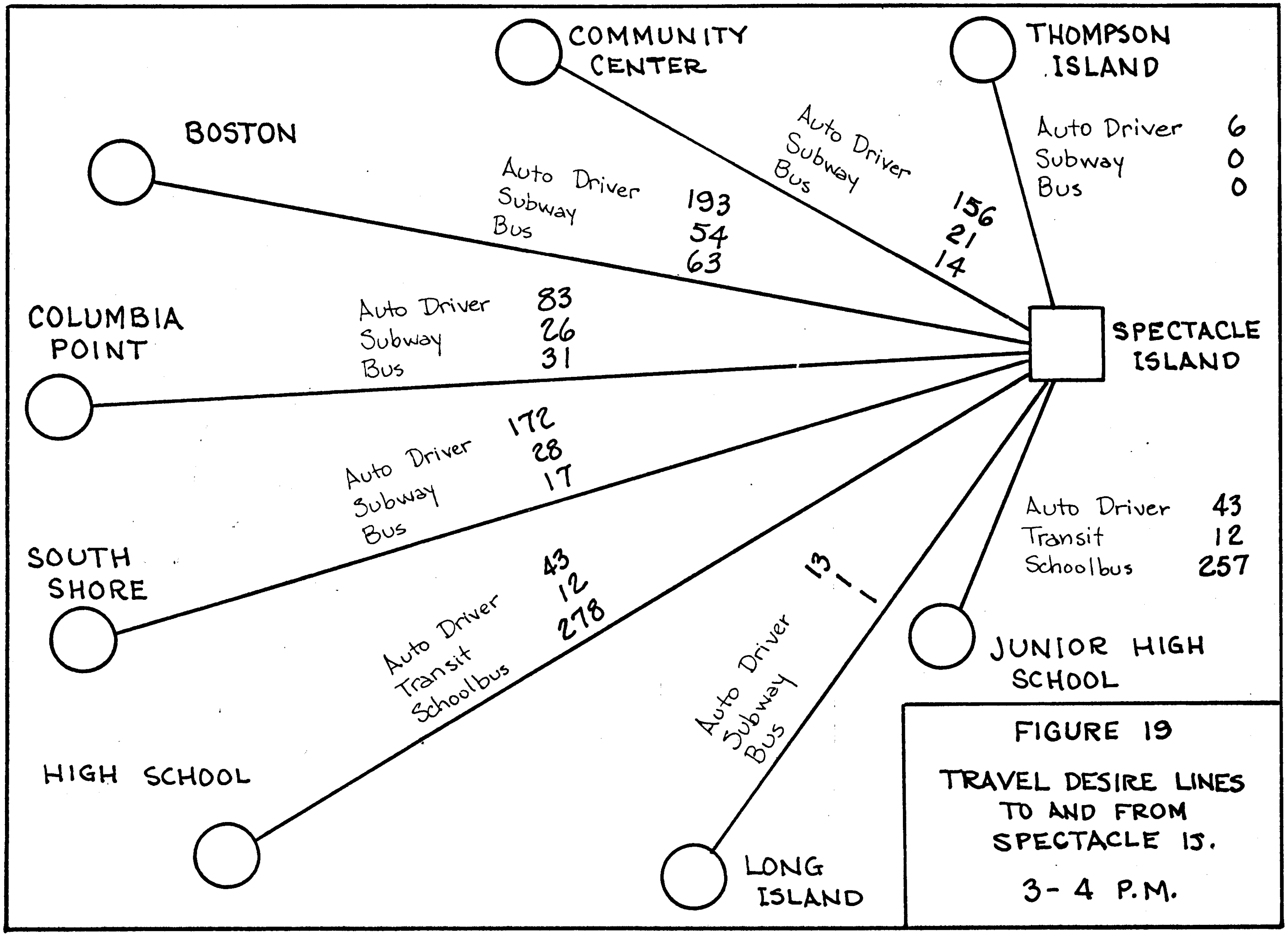



FIGURE 19

TRAVEL DESIRE LINES TO AND FROM SPECTACLE IS.

3- 4 P.M.

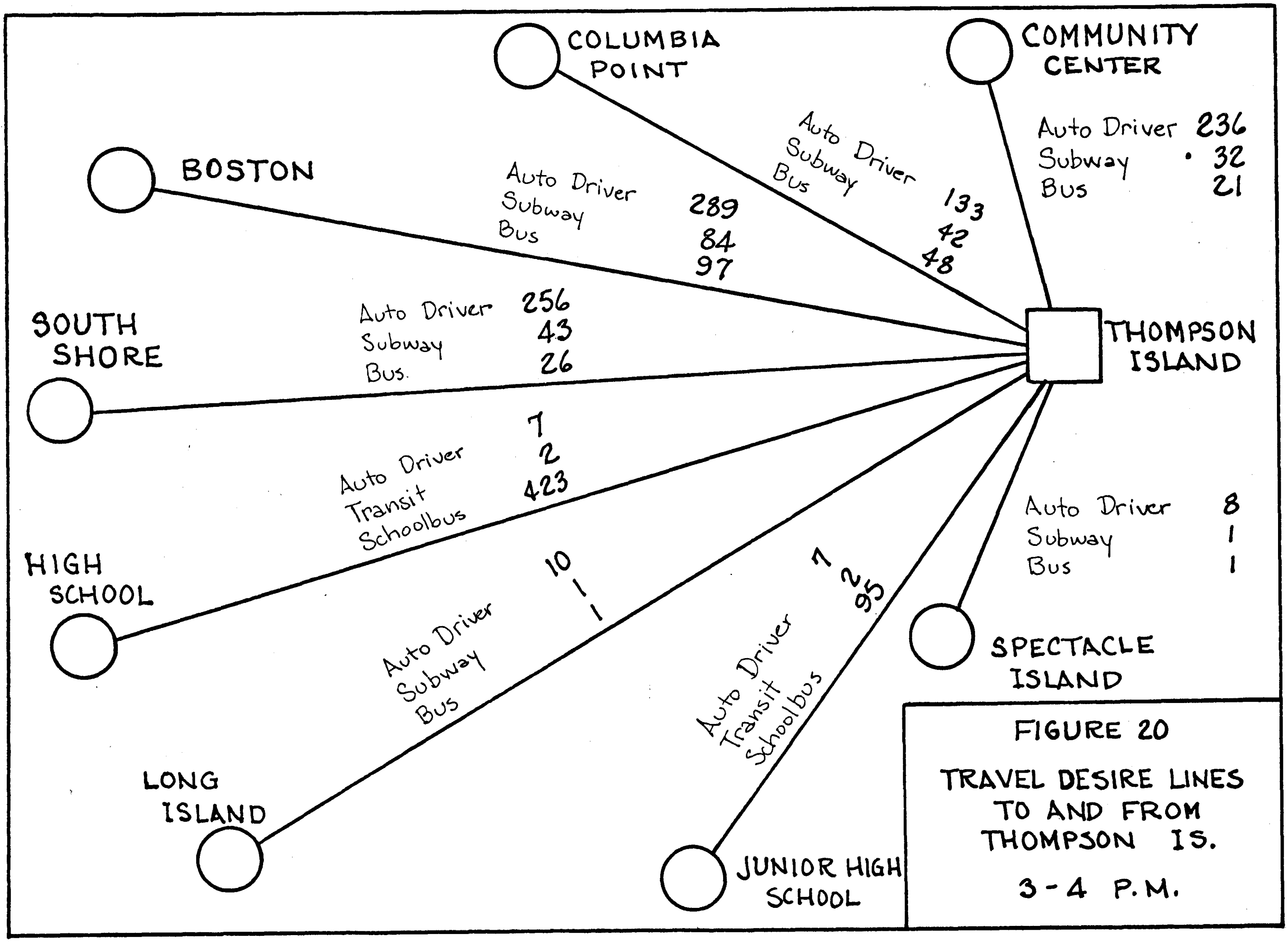



FIGURE 20

TRAVEL DESIRE LINES TO AND FROM THOMPSON IS.

3 - 4 P.M.

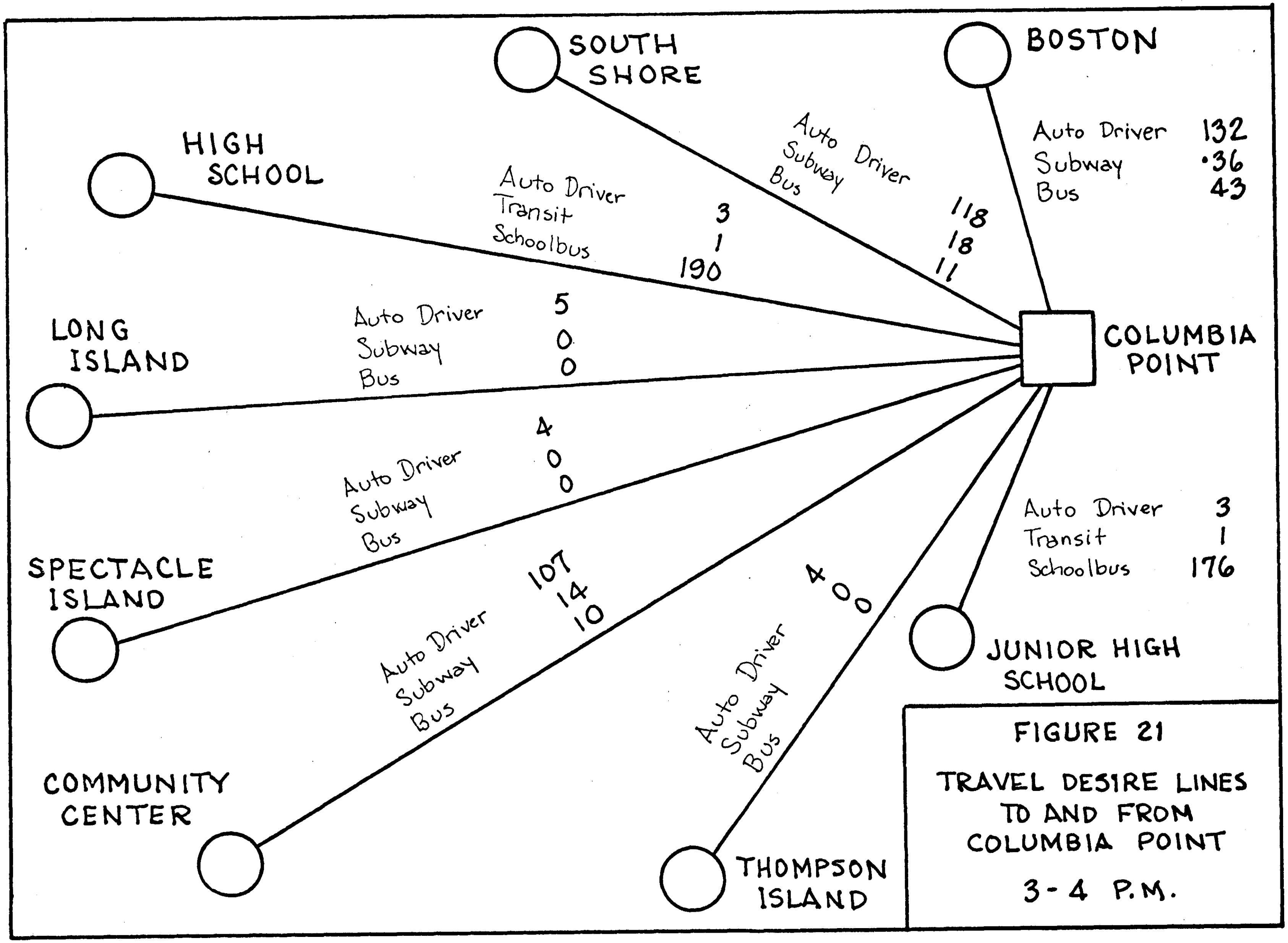



FIGURE 21

TRAVEL DESIRE LINES TO AND FROM COLUMBIA POINT

3 - 4 P.M.

### 3.2.5 Assumptions Inherent in Preceding Analysis

Before proceeding further, we will review the assumptions underlying the development of the travel desire lines (Figures 14 - 21).

(1) We have assumed that the 1963 Boston Transportation Study is applicable to the New Community problem, since the New Community population distribution agrees reasonably well with the study area distribution.

(2) Our results are based on the level of transportation service (and patronage) existing in Boston, 1963. If the New Community installs a conventional mass transit system, Figures 14 - 21 are probably a satisfactory first-cut modal split. However, we envision at least some moves being made toward an innovative New Community public transportation system. Such moves would decrease our auto traffic estimates in favor of transit usage.

(3) Our results depend heavily upon the assumptions represented by Table 13. We do not anticipate any more accurate information on trip destinations until the New Community plan is firmly established, and its population make-up and public and private facilities known.

(4) Our estimates do not include trips to the New Community by non-residents. Such trips are expected to be opposite in direction to the larger flow of New Community traffic, and would not upset our road or transit capacity calculations.

(5) The only forseeable contradiction to Statement (4) would arise from the location of a regional recreation facility -- beach, amusement park, marina -- within the New Community. If such a facility were planned, we would recommend access by transit alone to alleviate congestion and the parking problem.

(6) Finally, our study is based upon "normal" living styles such as unrestricted private auto ownership and a nine-to-five working day. Although some of these conditions may change in the New Community, it would then be easier to adjust our predictions accordingly, rather than to initiate a separate study.

## 3.3 Location of Routes to Fit Desire Lines

The origin-destination studies (Figures 14 - 21) suggest the need for substantial links to the mainland, as well as a good internal circulation system. For the internal circulation system we propose a simple linear route from Thompson Island through Spectacle Island to Long Island. (See map, Figure 22.) Linking to the mainland, however, is beset with economic, physical, and political problems. We discuss several alternative schemes below. (Again, see Figure 22.)

### 3.3.1 Deer Island Connection

A bridge or tunnel between Deer Island and Long Island is judged infeasible for these reasons: (1) the difficulty and expense involved in crossing President Roads, the major channel into the Harbor; (2) the disruption such a link would cause in the residential sections of Winthrop and Orient Heights; and (3) the lack of major facilities to tie into on the Winthrop peninsula.

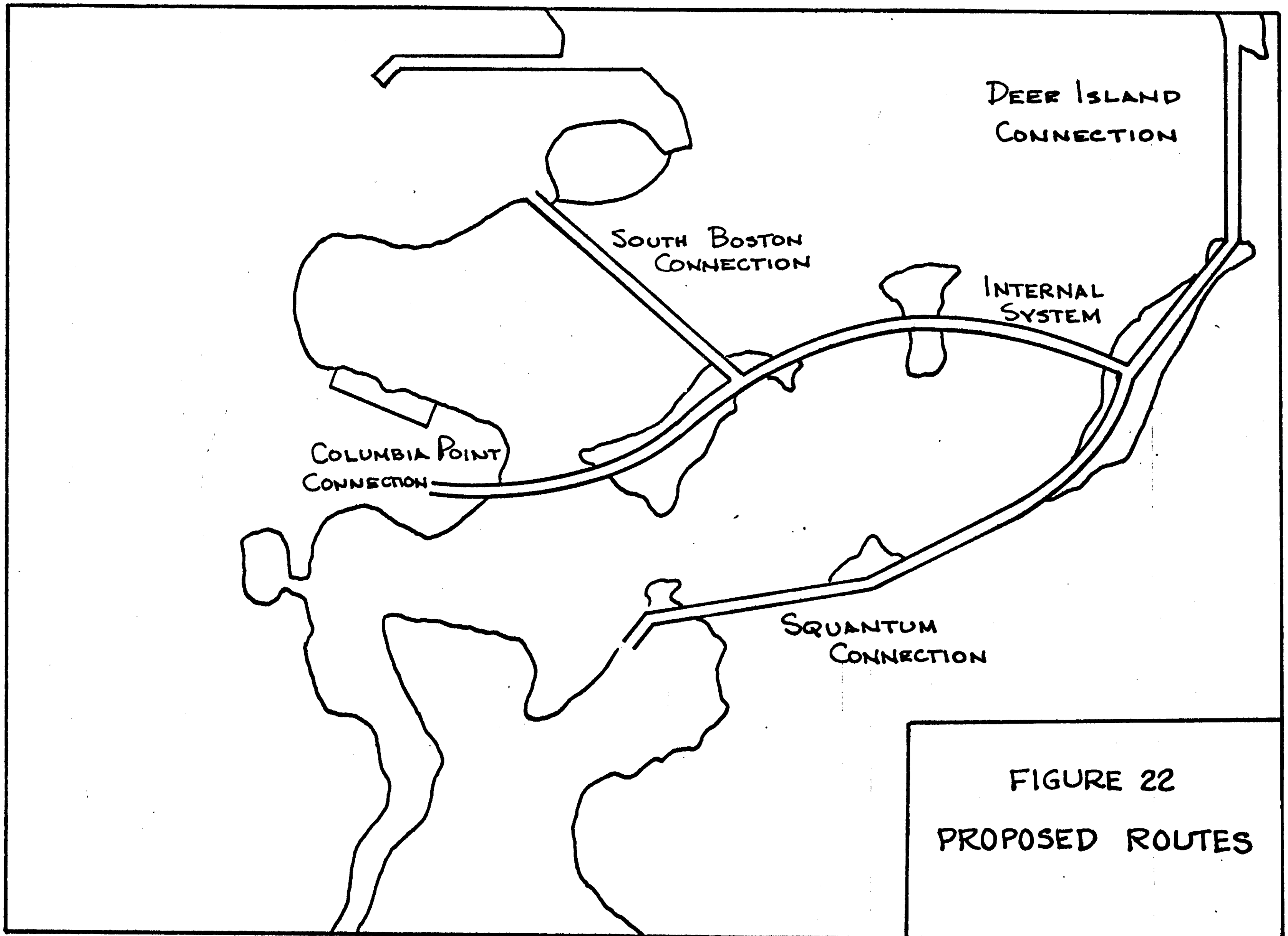



FIGURE 22
PROPOSED ROUTES

### 3.3.2 Columbia Point Connection

Columbia Point offers many possibilities as a gateway to the New Community. The proximity of the Southeast Expressway, Morrissey Boulevard, and MBTA rapid transit provide needed corridors to downtown Boston and to the Route 128 - South Shore area.

A vehicular connection could be built between Thompson Island and the tip of Columbia Point. The Columbia Point approaches would include construction of a road paralleling the existing Mt. Vernon Street and new interchanges on Morrissey Boulevard and the Southeast Expressway. (The existing interchange at Columbia Road, involving two expressways, three arterial roads, and two rotaries, would be too complicated to reconstruct.)

Probably the major limitation on this connection is its uselessness for peak hour travel to and from downtown Boston. The Expressway northbound becomes saturated from 7 to 9 each morning; southbound, from 4 to 6 in the evening. We will discuss two possible solutions to this problem in Section 4.5.

The MBTA's Columbia Station can serve as the New Community's transfer point to downtown and to the South Shore. Originally, the possibility of extending a steel track spur from the station to the Community (thus providing direct service to downtown) was considered. However, the Ashmont line will merge with the new South Shore line just north of this station. We consider the inclusion of a third branch not only an unnecessary complication, but also a limitation on our choice of vehicles. The proposed transit connection can use express buses, electrically powered buses, or automated, rubber tired vehicles on a guideway.

### 3.3.3 Squantum Point Connection

Long Island is presently served by a two-lane road which extends from Dorchester Street in Squantum across a causeway to Moon Head and over a steel truss bridge to Long Island itself. The existing Long Island bridge, 23 feet in width (plus a cantilevered sidewalk), would provide ~~a~~ rudimentary access to the New Community.

To make this route serviceable, a new bridge must be constructed, the Moon Head causeway widened, and a new road built to Squantum. Dorchester Street in Squantum itself is in good condition for moderate speed traffic. Its curves are too sharp for high speed use, and the abutting residential neighborhood precludes construction of a wide expressway.

At this writing, Squantum is politically opposed to harbor developments within its jurisdiction. We doubt whether the above proposals would meet with favor there today. Of course, political views can change before the New Community is built. For the purposes of this study, however, construction of new connections to Squantum will not be considered. (We will treat the existing Long Island Bridge as an emergency route to the Community, as for fire apparatus or ambulances. We do not envision large volumes of everyday traffic using it.)

### 3.3.4 South Boston Connection

A vehicular connection could be built to the existing William J. Day Boulevard at Castle Island in South Boston. This boulevard could then carry New Community traffic to Morrissey Boulevard, Old Colony Avenue or the Expressway.

The possibility of constructing a new road through the terminal areas and the military bases on the northern edge of South Boston was also considered. Not only does this route present potential right-of-way difficulties (such as active terminals or tank farms near Castle Island), but it also leaves unsolved the problem of where to funnel the traffic downtown.

A rapid transit line, if elevated, would have more flexibility in location. One possible route is from Castle Island to First Street to Summer Street and downtown. The supporting structure would have to be compact and aesthetically pleasing; columns could be placed along the centerline of the streets (in a design similar to San Francisco's BART).

South Boston, like Squantum, opposes harbor developments. Residents would therefore probably resent the New Community traffic and the transportation structures slicing through their neighborhood. For this reason, we do not consider a South Boston connection feasible.

### 3.3.5 Water Transportation

In light of the abovementioned difficulties with land connections, we studied the feasibility of water transportation to the islands via hovercraft, hydrofoils, or ferries.

Our analysis rejects the feasibility of heavy Community dependence on water transportation for the following reasons:

(1) A fleet of watercraft numerous enough to serve the New Community is expensive to purchase, operate, and maintain. (This is not to say that a limited fleet would not be profitable. As a matter of fact, a thriving market for hydrofoil, hovercraft, or ferry service might be found for a shuttle run to Logan Airport or for a sightseeing cruise around the Community.)

(2) Service would be at discrete, scheduled times, rather than on a continuous basis (such as is available with the automobile). Rush hour commuters are likely to become impatient, as well as cause congestion at the loading platforms.

(3) Because the trip from the islands to the mainland is short, loading and unloading times become a significant, and wasteful, part of the trip.

(4) Because of high operating and maintenance costs, the craft should be as fully loaded as possible on each trip. This would not happen at rush hours, when traffic is directional.

(5) Vehicular access will have to be provided to the islands anyway, to serve freight and delivery trucks and emergency vehicles. If this access is provided, we see no need to force commuters and shoppers to take less convenient water transportation.

### 3.4 Projected Peak-Hour Demands

Clearly the Columbia Point connection is the most feasible of the five alternatives studied. Our preliminary network is therefore linear, continuing from Columbia Point via Thompson and Spectacle Islands to Long Island.

Using this linear route, we have applied the origin and destination results (Figures 14 - 21) to the three land use patterns (Figures 11 - 13). Results, in terms of peak-hour traffic on the system, are shown in Figures 23 - 28. (Note that the subway and bus modes used previously have been combined under a single transit mode.)

A quick observation from Figures 23 - 28 is that Land Use Plan I, currently in use on the New Community Project, results in the heaviest traffic

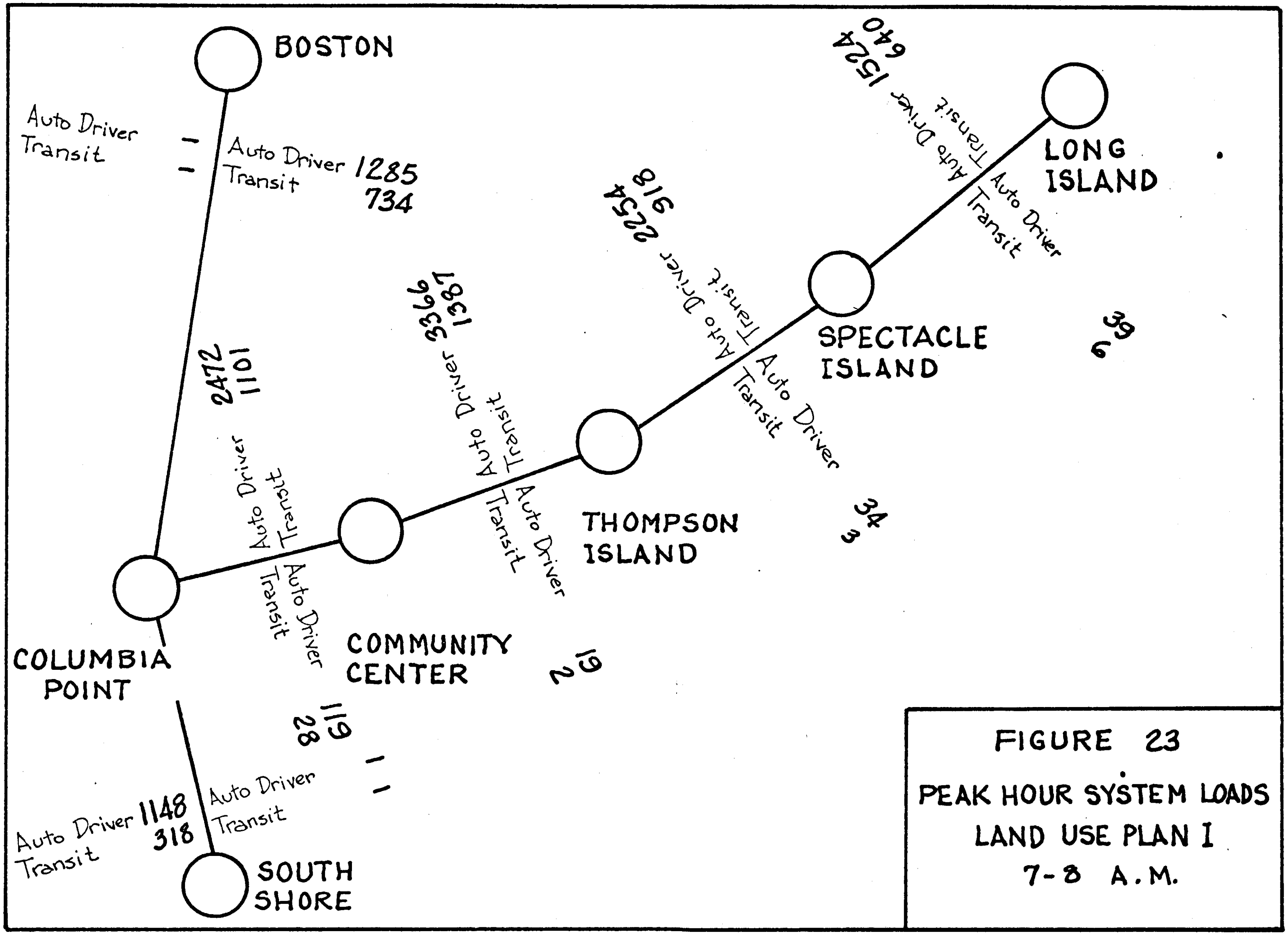



FIGURE 23

PEAK HOUR SYSTEM LOADS

LAND USE PLAN I

7-8 A.M.

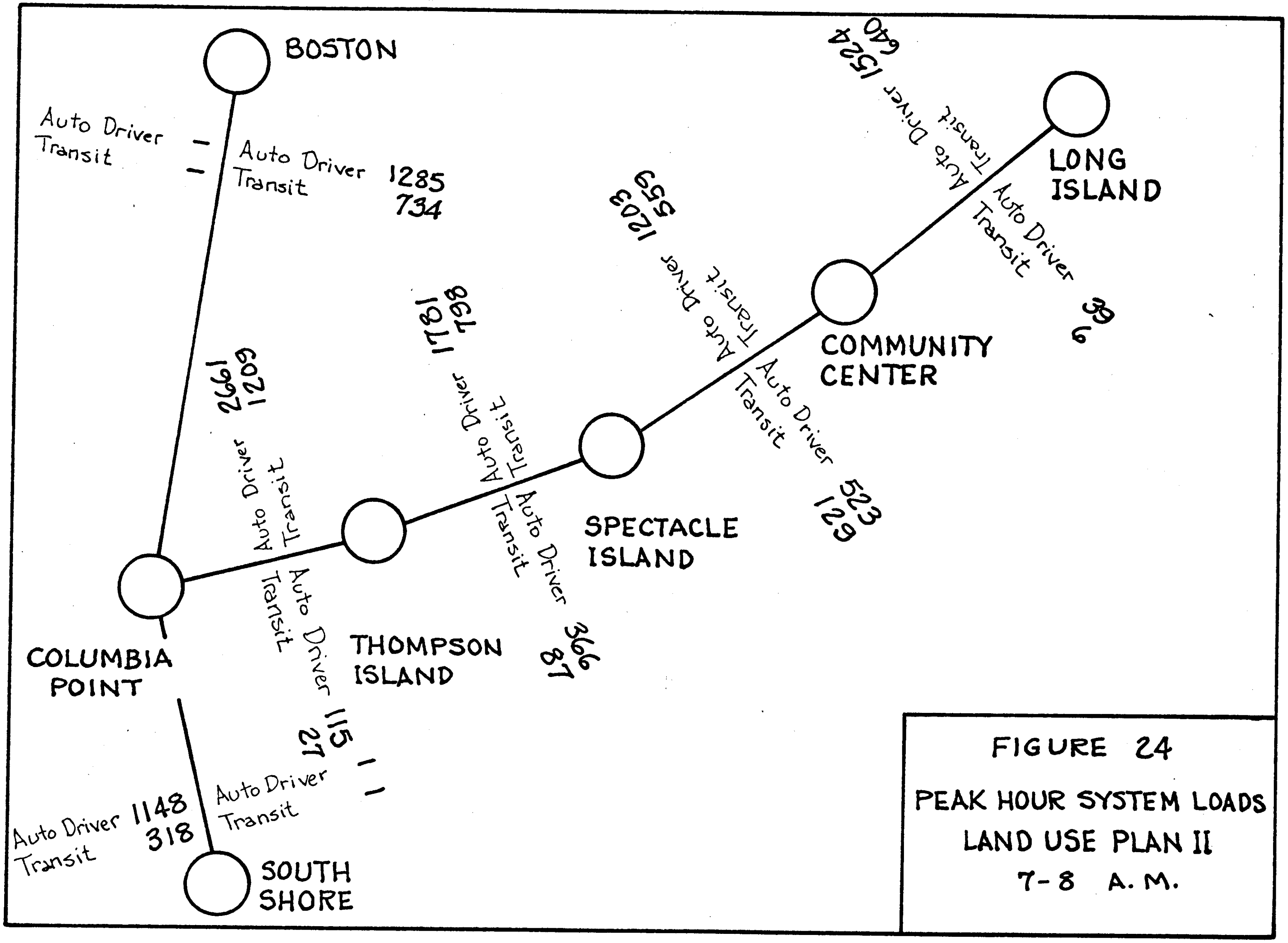



FIGURE 24
PEAK HOUR SYSTEM LOADS
LAND USE PLAN II
7-8 A.M.

65

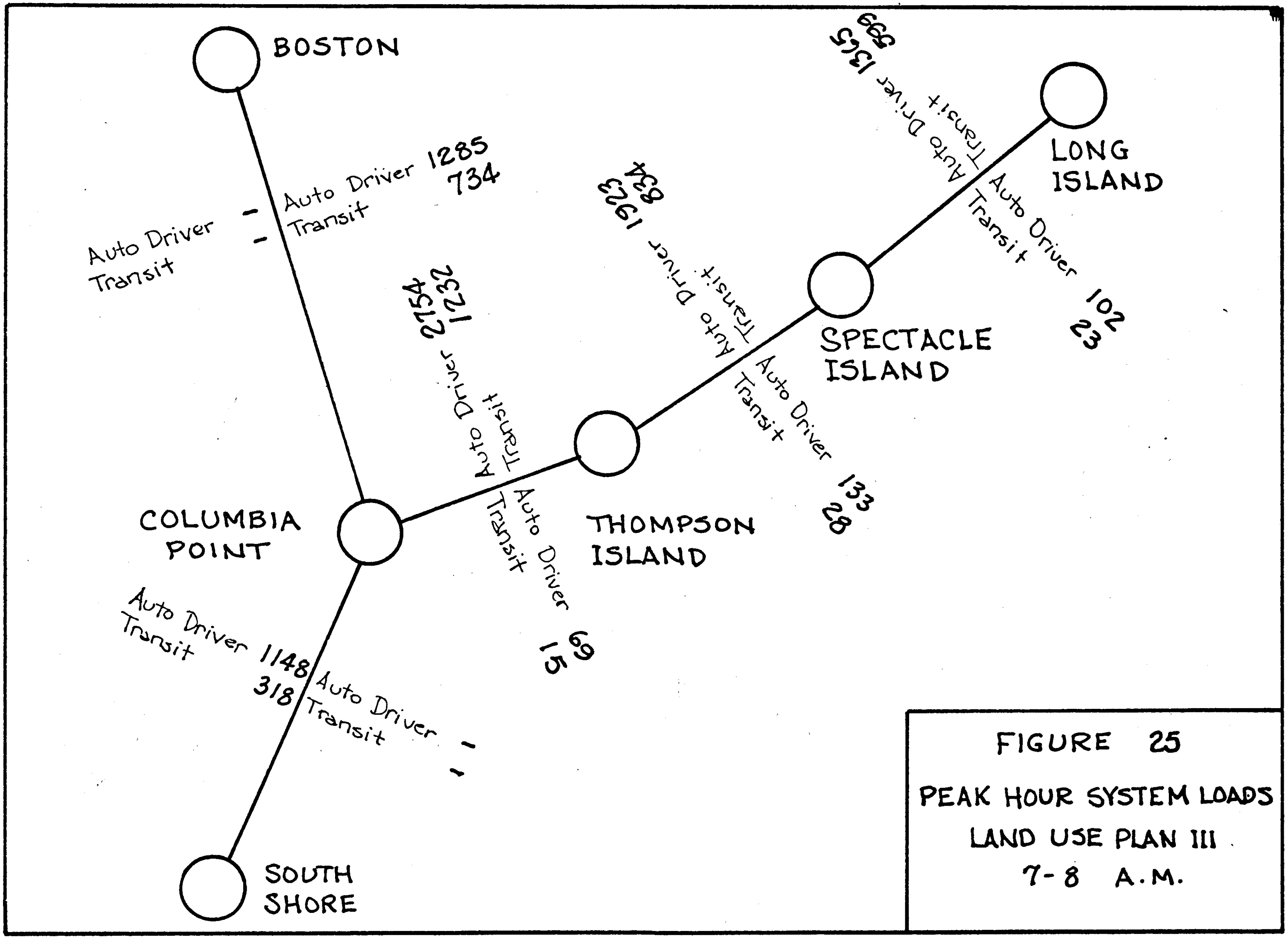



FIGURE 25

PEAK HOUR SYSTEM LOADS

LAND USE PLAN III

7-8 A.M.

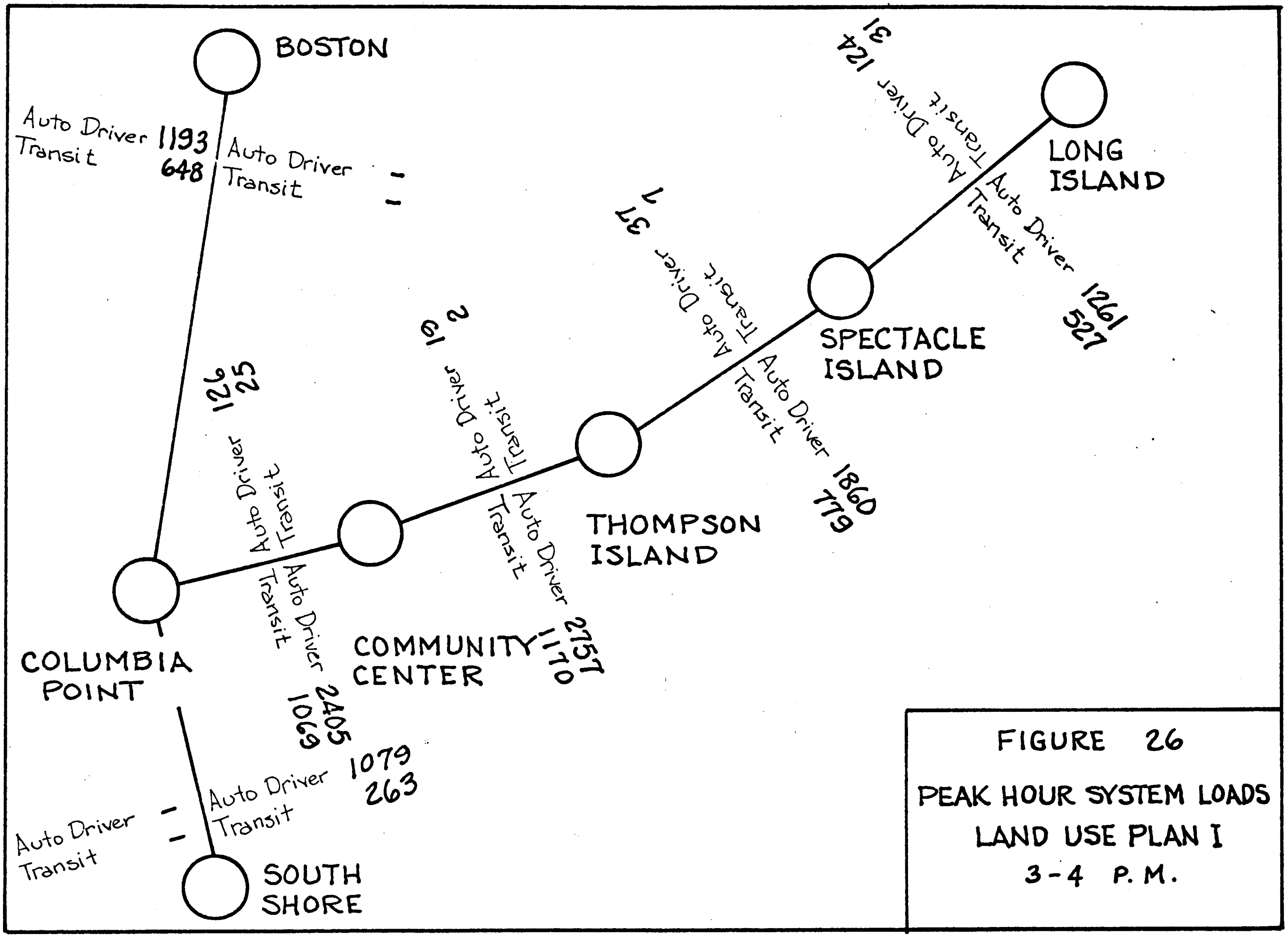



FIGURE 26

PEAK HOUR SYSTEM LOADS

LAND USE PLAN I

3 - 4 P. M.

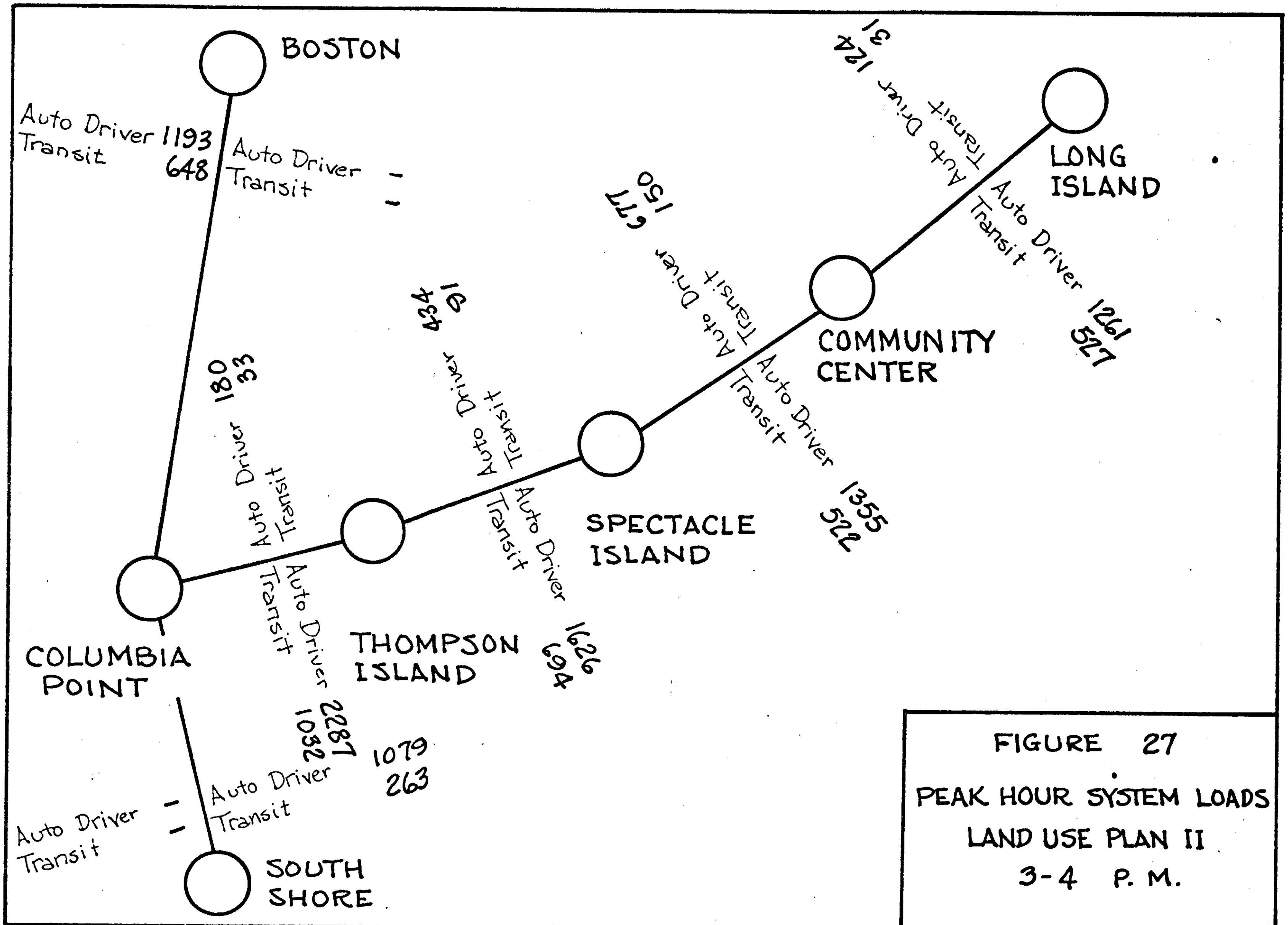



FIGURE 27

PEAK HOUR SYSTEM LOADS

LAND USE PLAN II

3-4 P. M.

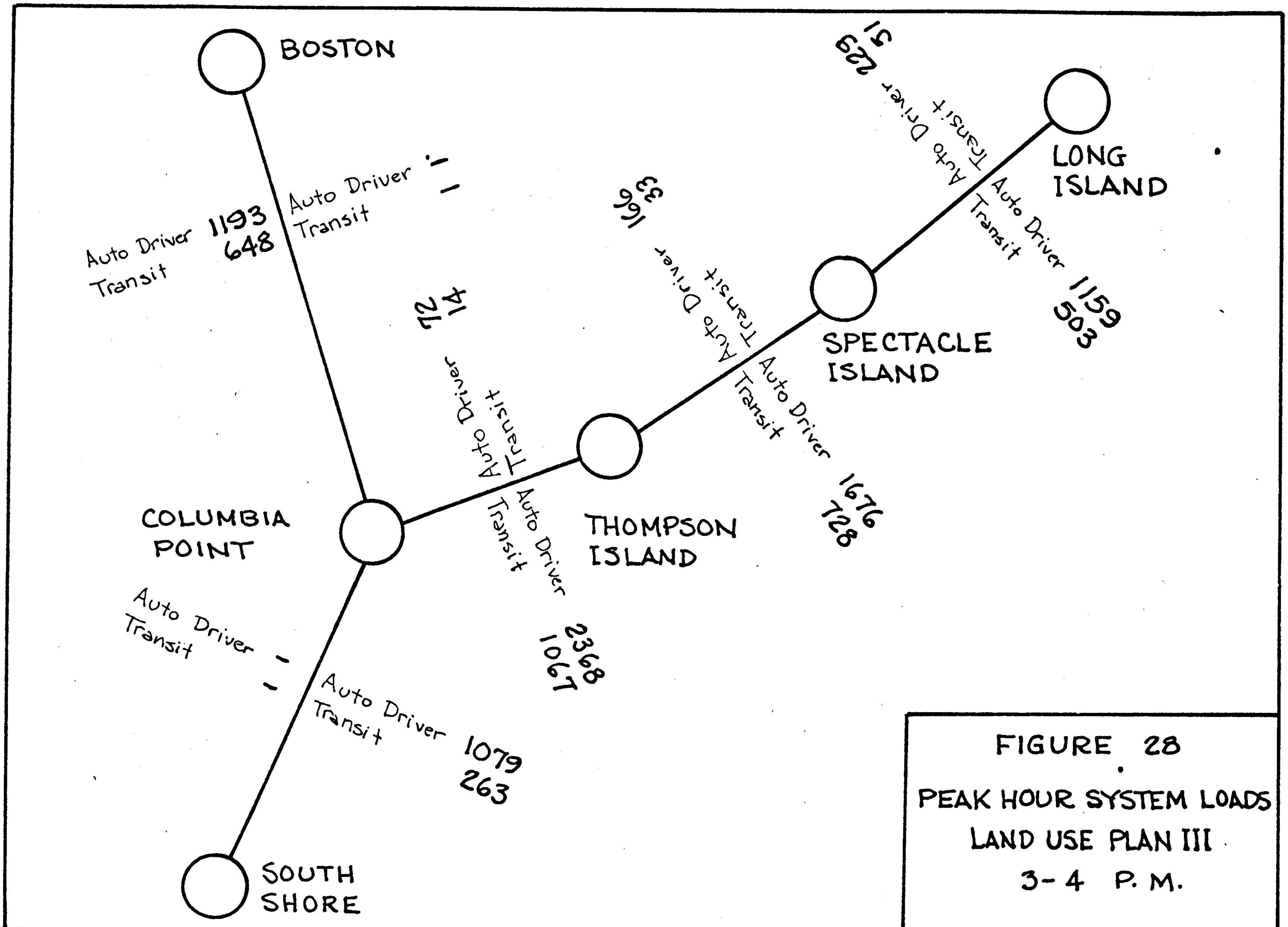



FIGURE 28

PEAK HOUR SYSTEM LOADS
LAND USE PLAN III
3-4 P.M.

flows. Plans II and III are advantageous at different points in the network; judgement between them will be reserved until they are costed.

### 3.5 Alternative Solutions (Modes)

Two types of service are required in dense urban areas: line-haul, and collection-distribution. Line-haul service carries large volumes of traffic along a narrow corridor in the swiftest, most efficient manner possible. Figures 23 - 28 represent a demand for line-haul service.

Collection-distribution service carries passengers from their origins to their destinations. Because of the multiplicity of individual origins and destinations, the collection-distribution service is usually either inefficient but personal (e.g. door-to-door automobile ride at the price of congestion), or efficient but personally unsatisfying (e.g. a bus line that stops a few blocks from home). Because a complete New Community plan is not yet available, we have not made detailed quantitative estimates of demand for collection-distribution on each of the islands.

Barton-Aschman Associates ( 3 ) have surveyed available and future modes to assess their applicability in different situations . From their study we conclude that among currently used modes, the automobile and street transit are applicable to urban collection-distribution service, while express buses, low speed (less than 40 mph) rail and automobiles are applicable to urban line-haul service.

Among future modes, Barton-Aschman Associates find that dual travelway vehicles (i.e. cars or buses which can travel on both regular roads and special guideways) or small manually controlled vehicles might be suited to urban collection-distribution, while automatically controlled vehicles, pneumatic tubes, monorails, or dual travelway vehicles could perform line-haul service.

## 3.6 New Strategies

The future modes alluded to in the preceding section represent one phase of an essentially nationwide effort today to increase public transportation use while reducing dependence on the automobile. Two objectives are in sight: (1) the offering of transportation opportunities to move segments of our society, particularly the young, old, and poor; and (2) the reduction of peak-hour automobile congestion in our cities.

Boston has joined this effort by planning extensive improvements in the MBTA transit system. (See Figure 5). The 1968 Eastern Massachusetts Regional Planning Project Report (11), which recommends these improvements, projects a reversal in the recent downward trend of transit travel. (From 1950 to 1960 there was a 35 per cent loss in patronage.) According to the EMRPP, the current revitalization of MBTA facilties has already had beneficial effects on the number of riders. Based on 1963 usage, a 45 per cent growth in transit travel is expected by 1990.

However, the EMRPP report also predicts substantial increases in automobile ownership and travel. Therefore, we cannot really say that the MBTA expansion will improve automobile congestion; it may, however, permit more people to travel who otherwise could not have.

As far as the New Community is concerned, studies reported by Meyer, Kain, and Wohl and Stanford Research Institute indicate that economic incentives to encourage drivers' switching from auto to transit probably would not work. Drivers apparently do not weigh heavily the costs of owning and operating an automobile, but are very sensitive to transit fares. In addition, SRI reports that "at the lowest income levels, at least one-third of new car buyers place sufficient value on pride of ownership and status to justify the purchase of expensive cars. More than half of the buyers in the high income group display this attitude," Therefore, any economic incentives would have to include not only a driver's valuation of transportation, but also the status value of his automobile.

We recommend, as a better policy, provision of good, quick, clean, and comfortable transit service for those who cannot drive. SRI reports that on the transit systems of eight cities, so-called captive riders (those who have no other transportation available to them) comprise 56 to 91 per cent of all transit riders.

One of these eight cities, Pittsburgh, (with 85 per cent of its transit riders captive) conducted a study of passenger characteristics. As might be expected, the majority of captive trips are made by those under 15 or over 35 years old. Most captive riders are laborers, domestics, operatives, sales workers, or school children. The white collar professional, technical, or managerial workers, and blue-collar craftsmen and foremen, ride transit by choice.

A corollary to the above recommendation for good public transit is that a high level of service (such as might be provided by a dial-a-bus system) would do more to attract auto drivers than would the previously mentioned economic incentives. Meyer, Kain, and Wohl quote a Fortune Magazine survey suggesting substantial diversion to transit from autos <u>if</u> the transit travel time is at least as low as present auto travel times.

In addition, an experiment in Mansfield, Ohio, shows that public transit <u>can</u> reverse a declining trend in patronage through innovations in equipment, routing, scheduling, and service. Having found that a common characteristic of failing transit systems is large, old, and unattractive equipment, the Mansfield Transit Company purchased Ford Econolines for their system. They determined routes such that no passenger is more than two blocks from a route. Stops are made in the middle of blocks as well as at corners. Because of scheduling and routing, no one is on the bus more than 10 minutes. As a result of these improvements, the Mansfield Transit Company is enjoying a successful operation.

## 3.7 Environmental Matters

This section presents some environmental guidelines we feel should be incorporated in the design of the New Community transportation system.

### 3.7.1 Traffic Segregation

Where possible, local and pedestrian traffic should be separated from arterial traffic. Furthermore, surface arterial traffic should be routed between, for example, residential and commercial areas, rather than through neighborhoods. The benefits of these steps are more pleasant neighborhoods and increased pedestrian safety.

### 3.7.2 Aesthetics

Travelway structures and public transit vehicles should be aesthetically pleasing and unobtrusive. Where roads and rail transit must pass through residential neighborhoods, they should be either depressed or elevated on attractive structures. Portions of the San Francisco BART system that are elevated in corridors of linear parks are examples of aesthetic treatments. See Section 4.4.1 for further suggestions.

### 3.7.3 Noise and Air Pollution

Noise and air pollution should be considered in the choice of public transportation vehicles. Quiet operation favors electrically powered, rubber tired vehicles. Electric motors are also favored from the air pollution standpoint. The disadvantage of electricity is the difficulty of providing a lightweight, cheap, and efficient portable power source. Presently, electric buses derive power from overhead lines, which are unsightly. The only convenient solution we see now is that if automatically controlled vehicles are developed in time for use in the New Community, power can be supplied by a "third rail" in the guideway.

### 3.8 Chapter Summary

In this chapter we have studied physical, social, and political constraints placed upon the New Community transportation system. Because of available land restrictions, the New Community will not have an extensive street network. Multiple use of land will be encouraged.

Vehicular access to the New Community will be via Columbia Point. Water transportation may be provided, but on a limited scale only.

The New Community, at peak hours, will generate several thousand trips. Almost three thousand of these trips will be to or from the mainland.

Strong efforts should be made toward a good public transit system that can serve the young, old, poor, and those who cannot drive. With a sufficiently high level of service, public transit may also attract auto drivers, thus reducing congestion.

The choice of public transportation vehicles and the design and layout of travelways should enhance the pleasantness of the surrounding neighborhood.

## 4.0 TECHNICAL/PHYSICAL ASPECTS

Technical/physical aspects relate to the performance of the transportation system. Given the constraints and the alternatives developed in the previous chapter, we will study quantitatively the flow characteristics of these different alternatives. We will discuss the physical aspects of the island travelways, plus effects on the mainland system. Finally, we will look at the New Community parking problem.

### 4.1 Modal Characteristics

The available literature is replete with performance characteristics of current and future modes. (See, for example, references 3, 10, 12, 14, 25, 28.) We have summarized the available information in Table 14.

It is doubtful whether the future modes described in Table 14 could be operational in time for extensive New Cumminity service. Despite optimistic claims by inventors and developers, these systems are still in a rudimentary design stage.

Some forms of automatic "people movers" are currently being installed in areas of major public activity. For example, Braniff Airlines has constructed for $2 million a Jetrail to shuttle passengers from parking lot to terminal at Love Field in Dallas. Jetrail consists of a closed loop with three possible stops. Ten cars, each with a capacity of 14 persons, travel this loop at 15 miles per hour. The system has a theoretical capacity of about 1500 persons per hour.

To be applied to extensive New Community use, automated systems would

TABLE 14

SUMMARY OF MODAL CHARACTERISTICS

| MODE | SPEED (mph) | HOURLY CAPACITY (persons) |
|---|---|---|
| 1. Existing Systems | | |
| Moving Sidewalk | .1- 5 | 7200 |
| Monorail | 10-35 | 16000 |
| Express Bus | 25-40 | 8000-30000 |
| Rail Transit | 20-40 | 10000-40000 |
| Street Transit | 10-50 | 300- 8000 |
| Automobile | 10-60 | 300- 1000 |
| Minirail | 8-15 | 5000 |
| 2. Future Systems | | |
| Pedestrian Conveyor | 1-12 | 4500- 7200 |
| Automatically Controlled Vehicle | | |
| a. Small Vehicle | 30-60 | 5000-18000 |
| b. Large Vehicle | 20-45 | 4000-35000 |
| Monorail | 35-90 | 15000-20000 |
| Automatic, Dual Travelway Automobile | 50-90 | 5000-24000 |
| Small, Manually Controlled Vehicle | 12-20 | 600- 2000 |

require greater operating speeds and a more sophisticated control program than those used by Jetrail. The Alden StaRRcar concept is more in keeping with requirements for a high density urban area system. However, the StaRRcar prototype is in its early testing stages, and as of yet has no planned public demonstration projects.

For the above reasons we suggest reliance upon current transportation modes in designing the backbone (i.e. line-haul portion) of the New Community system. We believe that automated or computer-aided (e.g. dial-a-bus ) systems do have a future in the New Community. However, depending upon prior testing and acceptance, these future modes should be introduced in stages or on a limited collection-distribution basis.

## 4.2 Trip Profiles

To give an intuitive feel for the differences in service expected from various line-haul modes, we have prepared trip profiles (expressed in minutes travelling plus transferring). Our calculations are based on the 5.7 mile route from the southern tip of Long Island to Columbia Point.

### 4.2.1 Rail Transit

Meyer, Kain, and Wohl (19) point out that average speeds of 35 to 40 miles per hour are the maximum achievable by a well-designed rail transit system with one-mile station spacing. (The upper limit on average speed is caused by passenger loading and unloading delays, plus time spent during periodic braking and acceleration.) We will assume a 30 mph average speed. Travel time from Long Island to Columbia Station is therefore 0.19 hours, or 11 minutes.

### 4.2.2 Street Transit

Assuming an average speed via street transit of 20 mph, travel time is 0.29 hours, or 17 minutes.

### 4.2.3 Express Bus

The express bus mode utilizes an ordinary bus vehicle on a reserved or exclusive lane. The bus is therefore unhampered by surrounding traffic.

Assuming only one stop per island, we project an average speed of 30 mph, or a travel time of 11 minutes by express bus.

### 4.2.4 Automobile

Since the peak hour volume of automobile traffic is expected to be heavy (Figures 23-28), we will assume the main road to the islands to be a limited access, grade-separated freeway. Average driving speeds will then be about 45 mph during the off-peak hours, and about 30 mph during peak hours. Respective driving times are 8 minutes and 11 minutes.

## 4.3 Trip Profile Comparisons

The peak hour trip from Columbia Point to Boston takes 22 minutes by auto and 20 minutes by transit. If we assume a 2-minute transfer time at the Columbia Point MBTA station, we can estimate the peak hour travel times from Long Island to Boston via different New Community modes. See Table 15.

TABLE 15

PEAK HOUR TRAVEL TIMES
FROM LONG ISLAND TO BOSTON

| MODE | TRAVEL TIME (Minutes) |
|---|---|
| Rail Transit | 33 |
| Street Transit | 39 |
| Express Bus | 33 |
| Automobile | 33 |

Under our assumptions, rail transit, express bus, and automobile offer equal travel times to Boston. Street transit takes six minutes longer (which, over these short distances, is significant). It should be pointed out that the above travel times include time aboard the vehicle and in transfer only. They do not include the minutes spent walking to or from the station or parking the car.

## 4.4 Physical Characteristics of Facilities

### 4.4.1 Island Arteries

Figures 23 - 28 indicate heavy peak hour automobile traffic on the island arteries. Using a design capacity of 1200 vehicles per lane per hour (for an urban freeway), we anticipate that these arteries will in fact be four-lane and six-lane expressways.

Because of the limited amount of available land, these expressways should be integrated as completely as possible with the adjoining right-of-way. The sketches in Figure 29 offer some suggestions on how this may be accomplished.

There are two basic choices for the location of expressways on the islands: along the shoreline, or through the interior.

#### 4.4.1.1 Shore Expressways

Shore arterials would not disturb the continuity of the adjacent neighborhood; moreover, they would offer excellent scenic views of the Harbor and the Boston skyline. However, they may be difficult or expensive to construct in certain areas.

These areas occur where the island drumlins rise abruptly from the bay, offering little width along the shore for construction. Massive earthmoving operations, or expensive retaining walls, may be needed.

#### 4.4.1.2 Interior Expressways

Conceptually, the simplest type of expressway across an island is a surface road. The disadvantages of large, high speed surface roads, however, are (1) safety hazards; (2) their tendency to split a neighborhood; and (3) interference with local traffic. These difficulties may be overcome by (1) constructing pedestrian and cross-traffic structures on a different level (Scheme D); (2) depressing the expressway (Scheme E); or elevating the expressway (Scheme F).

### 4.4.2 Parking

Table 6 predicts that New Community inhabitants will own 14,340 automobiles. At 300 square feet per space, the New Community needs 99 acres for

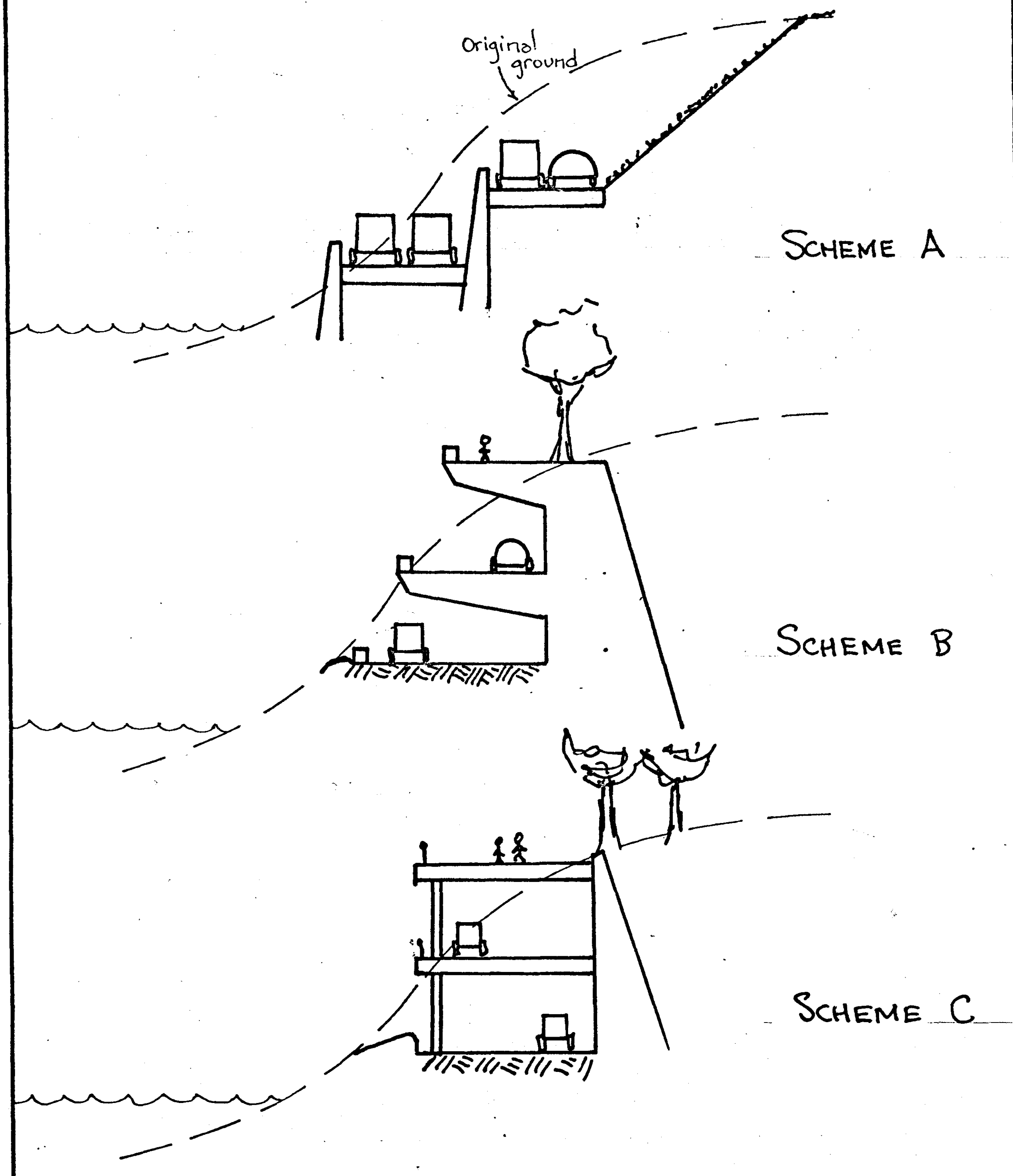



FIGURE 29. TYPICAL SECTIONS OF EXPRESSWAY SCHEMES

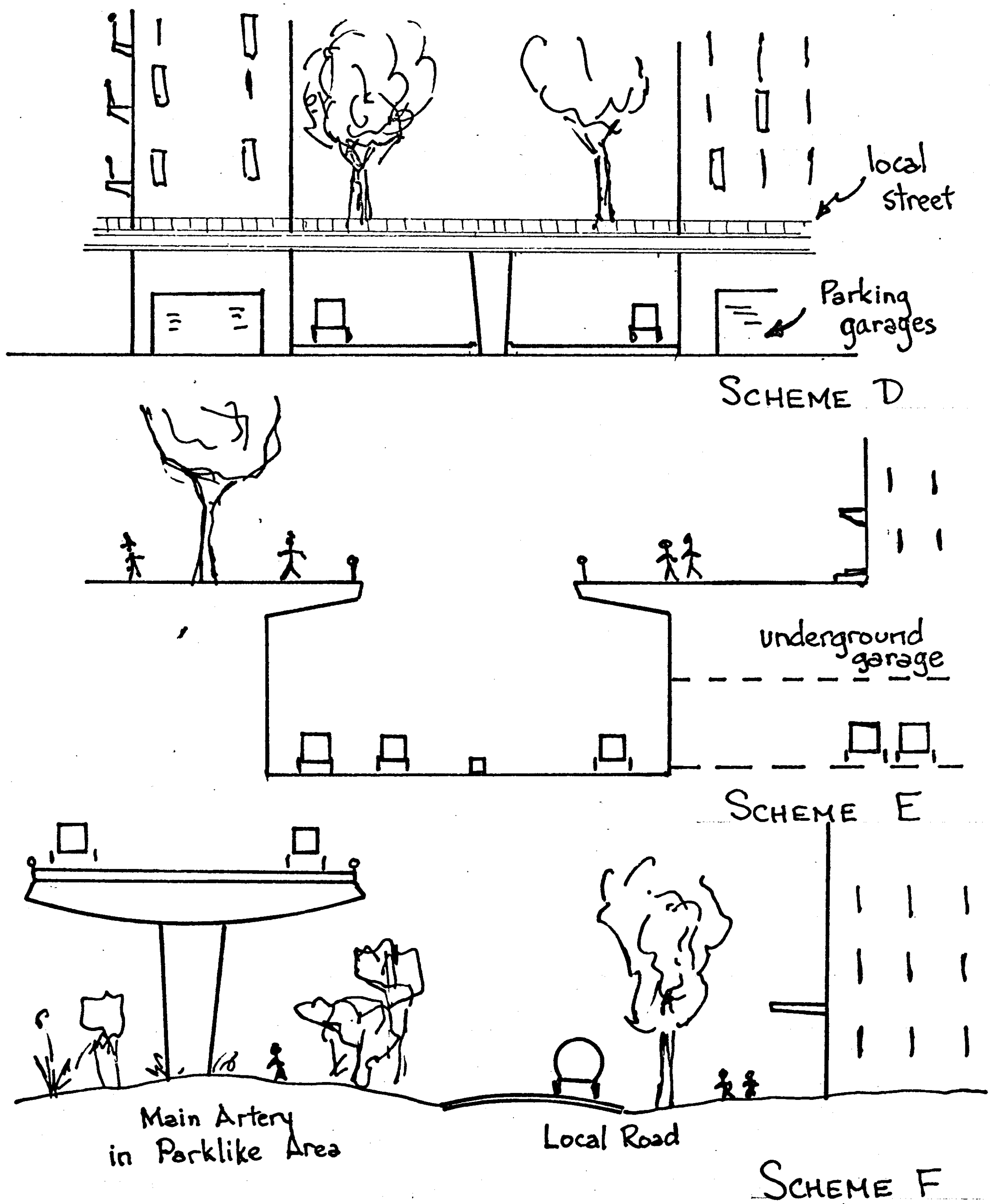



FIGURE 29 (CONTINUED)

residential parking. The 99 acres can be supplied by large community garages, smaller apartment garages, or on-street facilities.

4.4.2.1 Community Garages

We do not favor large community garages (i.e. garages which serve an entire island) because they defeat the door-to-door capability of the automobile. Some alternate form of transportation would have to shuttle passengers between the garage and their home, throwing an added burden onto the public system and inconveniencing the passengers as well. Moreover, the community garage would be a large structure (e.g. 200 ft by 200 ft, 23 stories high to provide 20 acres of parking space).

4.4.2.2 Apartment Garages

A better solution is the construction of garages to serve clusters of apartment towers. These garages can be located in lower levels of the towers, or over (or under) expressways (as suggested in the sketches in Section 4.4.1). They allow auto transportation right up to one's doorstep and are unobtrusive.

The largest apartment cluster now planned in the New Community Project is 480 units. Applying the unit parking factor of 1.14 (from Table 6), we get a parking requirement of 550 spaces, or about 3.8 acres. This could be satisfied by seven levels of parking within each of the three towers (assuming 75 ft by 100 ft plan dimensions for the towers); or, by one lot slightly larger than 400 ft by 400 ft; or, by four levels of a 360 ft by 100 ft garage constructed over (or under) an expressway.

### 4.4.2.3 On-street Parking

We considered the possibility of on-street parking, at least on local streets. However, we recommended earlier that local streets be kept to a minimum to conserve space. On-street parking should therefore be studied only if necessary garage space cannot be built.

### 4.4.3 Connection to Columbia Point

Any connection between Columbia Point and Thompson's Island will have to bridge or tunnel under Neponset Channel. Bridges are favored here because of their lower cost. The only statements on clearances we have received so far are from the Boston Gas Company, who require a tentative clearance of 70 ft above mean high water for tankers serving Commercial Point. The body of water separating Thompson's Island and Columbia Point is 4500 ft wide. Another 1500 ft are available (for approaches) on Columbia Point and Thompson's Island, giving a total bridge length of 6000 feet. To attain a clearance of 70 ft requires a grade of about 3 per cent, which is acceptable for vehicles.

### 4.5 Coordination With Mainland Expressways

Section 3.3.2 pointed out the severe peak hour congestion on the Southeast Expressway. This congestion, plus the expense of constructing interchanges with the Expressway and Morrissey Boulevard, lead us to suggest two possible alternatives for a vehicular route to Boston.

These alternatives, shown in Figure 30, are a bypass route paralleling the Expressway and to the east of it, and a connector to the Inner Belt.

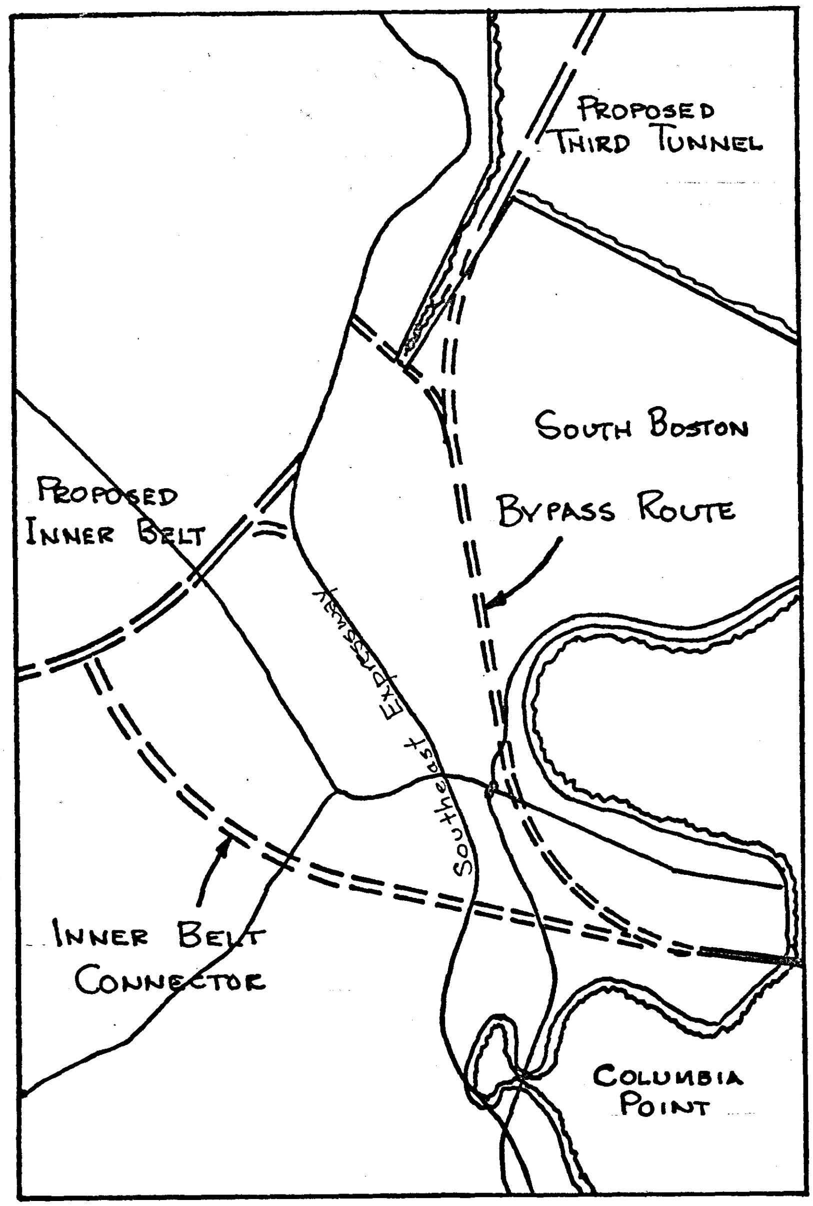



FIGURE 30. MAINLAND EXPRESSWAY ALTERNATIVES

4.5.1 Bypass Route

A bypass route has already been suggested publicly (under the label "I-95 bypass") to complement a third Harbor tunnel. The proposals have shown the I-95 bypass extending from the Massachusetts Avenue interchange on the Southeast Expressway to the third tunnel entrance. If the southern terminus of the bypass were, instead, at Columbia Point (adding 1.4 miles onto its proposed length), the New Community could have direct access to downtown Boston independent of the Expressway.

4.5.2 Inner Belt Connector

The completion of the Inner Belt will probably divert (in the morning rush hour) some of the northbound Expressway traffic that is destined for points west and north of Boston. Presently, this traffic must remain on the Expressway until it connects with other radials (e.g. Storrow Drive) downtown. The effect of the Inner Belt diversion is a lessening in Expressway traffic north of the Massachusetts Avenue interchange.

If a connector were built from Columbia Point to the Inner Belt, inbound New Community traffic could avoid the heavily congested portion of the Expressway. It would enter the Inner Belt and proceed eastward until it joined the Expressway at the Massachusetts Avenue interchange. While the New Community traffic would still meet some congestion on its way to downtown, presumably the conditions would be less severe with this connector.

## 5.0 EVALUATION AND CONCLUSIONS

In the preceding chapters we have identified the chief issues we feel surround development of the New Community transportation system. In as many instances as possible we have specified trade-offs among different design parameters. Unfortunately, the data available were often sketchy or incomplete. For example, two packets of information that would have been very useful are a detailed Community plan and a geologic survey.

We complete this report by making a final evaluation of the private automobile and the public transit systems in the New Community.

### 5.1 Private Automobile System

In Section 3.4 we showed that Land Use Plans II and III each have their beneficial aspects as far as traffic flow is concerned. We costed the respective expressway systems to see if there is an economic advantage to one of the plans.

Using a design capacity of 1200 vehicles per lane per hour, we discovered that one system serves both land use plans. This system, shown in Figure 31, has an estimated cost of $39.5 million. (Unit prices and assumptions are listed in the figure.)

Although the economic analysis seems to indicate that the two plans are equivalent, a second look at Figures 23 - 28 shows this is not so. Land Use Plan II reduces peak hour volumes because traffic to the commercial center is opposite the flow of the rush hour traffic. Land Use Plan III reduces trip volumes because many residents are able to travel to the smaller centers on their home islands.

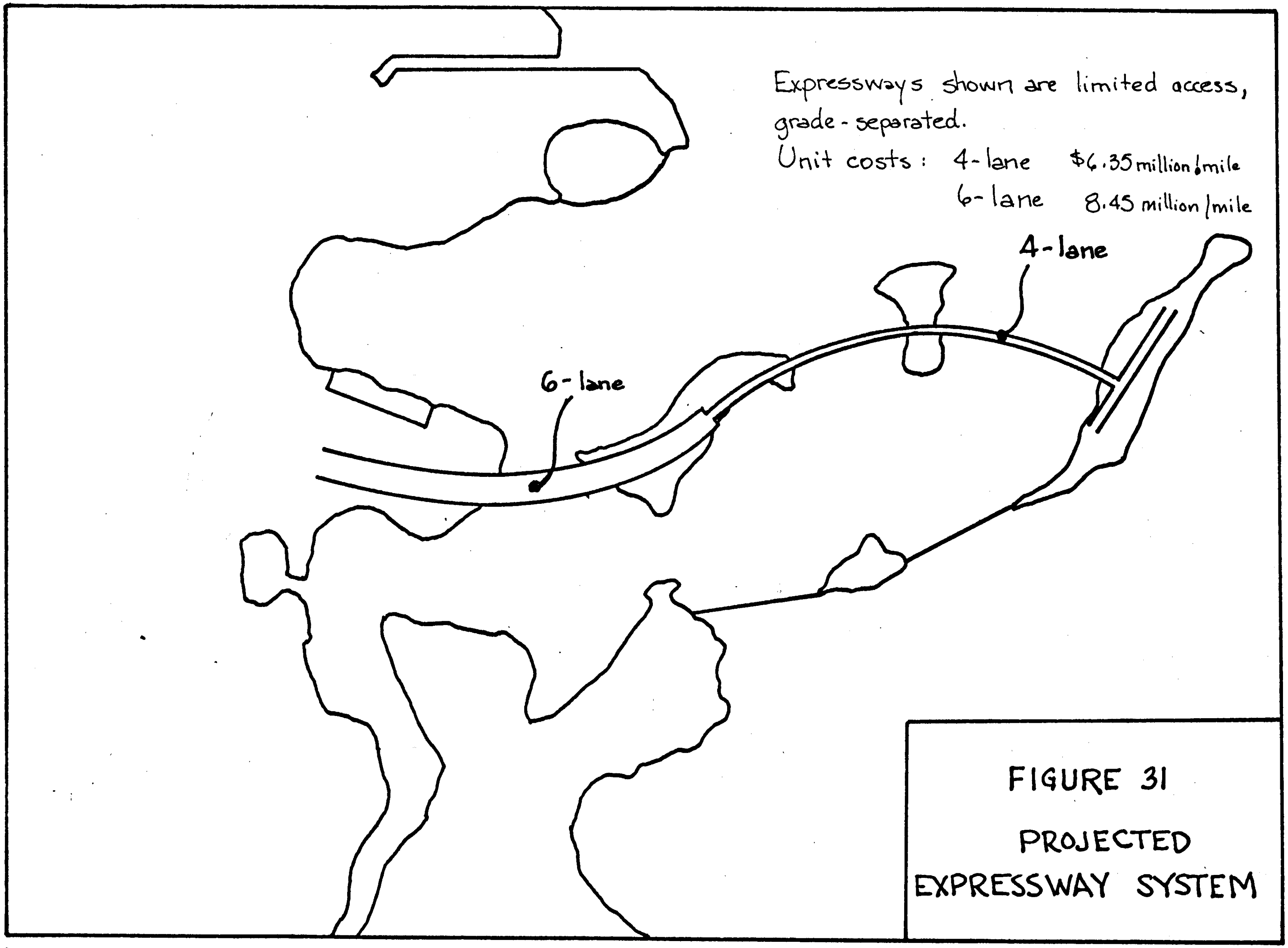



FIGURE 31
PROJECTED EXPRESSWAY SYSTEM

Because Land Use Plan III encourages shorter trip lengths, we feel it results in the most efficient expressway and road system for the New Community.

## 5.2 Public Transit System

In Section 4.3 we narrowed our choice of line-haul public transit modes to rail transit and express bus. After studying Figures 23 - 28, we feel that the projected demand dictates the choice of express bus.

We estimate a peak hour transit ridership of about 500 to 1200 persons. This is far too small a volume for conventional rail transit, which has a capacity of 10,000 - 40,000 passengers per hour.

On the other hand, express buses running every three minutes could handle the demand easily while providing the additional benefits of short waiting times and potential flexibility in routes.

A fleet of six buses would be adequate for peak hour service at three minute headways. We estimate purchase costs to be about $30,000 per vehicle and operating costs to be about $0.60 per bus mile (41). These costs compete favorably with those of rapid transit (from $60,000 to $160,000 for purchase of a rapid transit car, and operating costs of $0.60 per car mile). The costs of two additional lanes on the expressways for the exclusive use of these buses is $2 million per mile.

## 5.3 Preliminary Transportation Plan

We conclude this paper by displaying the preliminary transportation plan in Figure 32.

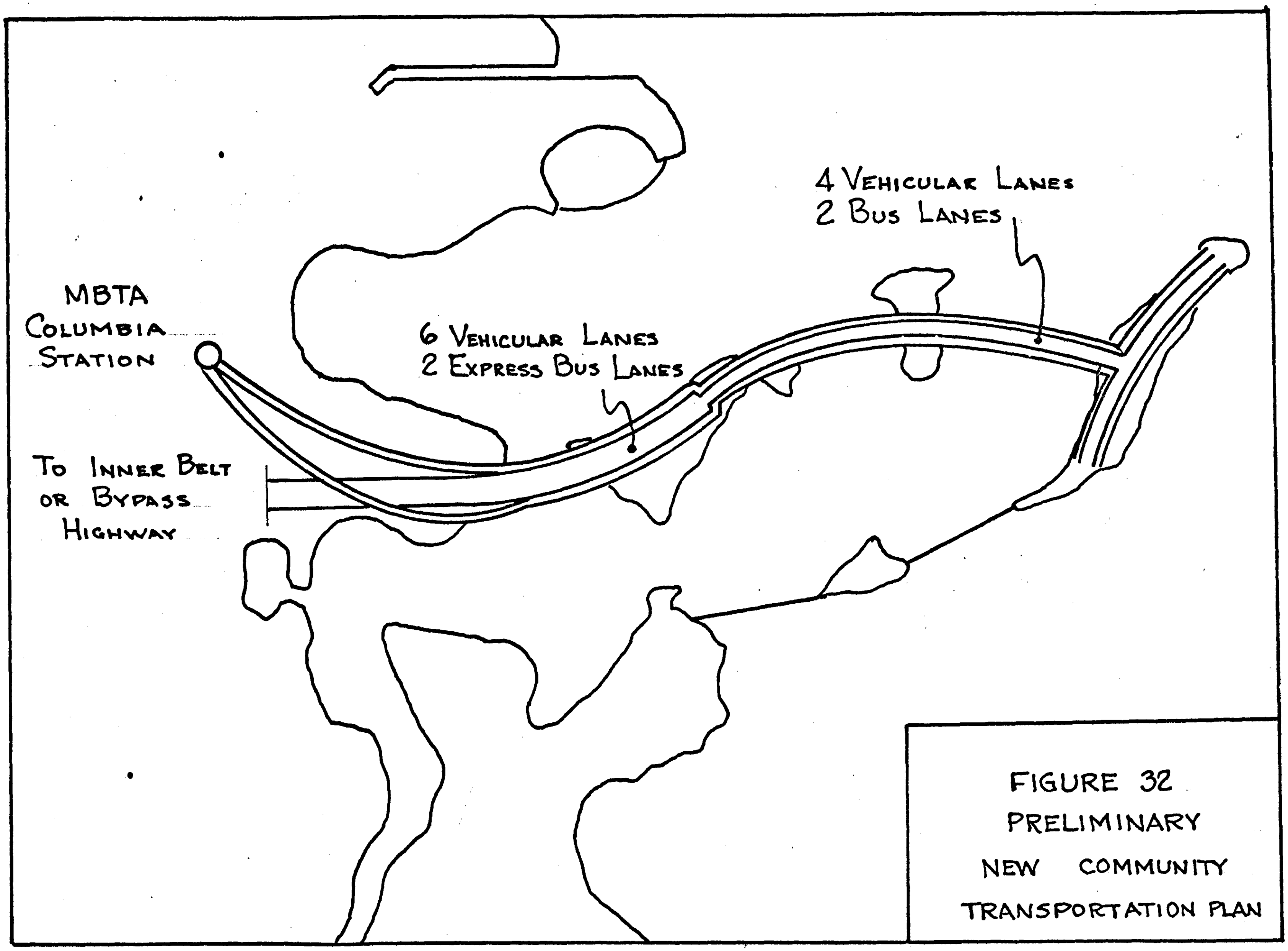



FIGURE 32
PRELIMINARY
NEW COMMUNITY
TRANSPORTATION PLAN

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# LIST OF FIGURES


| Figure No. | | Page |
|---|---|---|
| 1 | Proposed New Community Site . . . . . . | 7 |
| 2 | Existing Vehicular Routes . . . . . . | 9 |
| 3 | Proposed 1975 Network . . . . . . . | 10 |
| 4 | Existing Transit Lines . . . . . . . | 11 |
| 5 | Proposed 1975 Transit System . . . . . . | 13 |
| 6 | Travel Time Distribution . . . . . . . | 17 |
| 7 | Trip Length Distribution . . . . . . . | 17 |
| 8 | Distribution of Person-Trips, By Hour of Day . . | 30 |
| 9 | Hourly Distribution of Auto Driver Trips and Schoolbus Trips . . . . . . | 32 |
| 10 | Hourly Distribution of Transit Trips . . . | 33 |
| 11 | Land Use Plan I . . . . . . . . | 42 |
| 12 | Land Use Plan II . . . . . . . . | 43 |
| 13 | Land Use Plan III . . . . . . . . | 44 |
| 14 - 21 | Peak Hour Travel Desire Lines . . . . . . | 49 - 56 |
| 22 | Proposed Routes . . . . . . . . | 59 |
| 23 - 28 | Peak Hour System Loads . . . . . . . | 64 - 69 |
| 29 | Typical Sections of Expressway Schemes . . . | 82 |
| 30 | Mainland Expressway Alternatives . . . . . | 86 |
| 31 | Projected Expressway System . . . . . . | 89 |
| 32 | Preliminary New Community Transportation Plan . | 91 |

# LIST OF TABLES


| Table No. | | Page |
|---|---|---|
| 1 | Per Cent of Urban Land Devoted to Transportation . | 18 |
| 2 | Per Cent of Developed Urban Land Devoted to Transportation . . . . . . . | 19 |
| 3 | Income Distribution -- New Community and Study Area | 23 |
| 4 | Age Distribution -- New Community and Study Area . | 23 |
| 5 | Average Number of Cars Per Household: Boston Urban Region . . . . . . . | 25 |
| 6 | Estimated New Community Auto Ownership . . . | 25 |
| 7 | Total New Community Trip Production . . . | 26 |
| 8 | Daily Trips By Purpose and Mode . . . . | 27 |
| 9 | Daily Trips By Purpose and Mode (Adjusted for Home Trips) . . . . . . . | 29 |
| 10 | Distribution of Trips By Trip Purpose . . . | 35 |
| 11 | Age Distribution of New Community School Age Population . . . . . . . . | 38 |
| 12 | Daily Trips Between New Community and Mainland Centers . . . . . . . . | 39 |
| 13 | New Community Trip Origins and Destinations . . | 46 |
| 14 | Summary of Modal Characteristics . . . . | 77 |
| 15 | Peak Hour Travel Times From Long Island to Boston . | 80 |
| 16 - 19 | Modal Trips By Hour of Day and Purpose . . . | 97-100 |
| 20 - 24 | Purpose Trips By Hour of Day and Mode . . . | 101-105 |
| 25 - 28 | New Community Trip Production . . . . . . | 106-117 |

TABLE 16 - AUTO DRIVER TRIPS BY HOUR OF DAY AND PURPOSE

| Hour of Day (A.M.) | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Work | 364 | 128 | 192 | 21 | 192 | 470 | 2610 | 3340 | 1310 | 600 | 236 | 428 |
| Personal Business | 98 | 45 | 23 | - | - | 45 | 240 | 482 | 368 | 240 | 294 | 308 |
| Shopping | - | - | - | - | - | - | - | 106 | 223 | 445 | 875 | 705 |
| Social-Recreation | 79 | 93 | 16 | - | - | - | - | 54 | 93 | 179 | 218 | 358 |
| School | - | - | - | - | - | - | 18 | 236 | 139 | 25 | 7 | 36 |
| TOTAL | 641 | 266 | 231 | 21 | 192 | 515 | 2868 | 4218 | 2133 | 1489 | 1630 | 1835 |

| Hour of Day (P.M.) | 12-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Work | 835 | 706 | 1070 | 2250 | 2460 | 1900 | 470 | 364 | 236 | 428 | 364 | 428 |
| Personal Business | 391 | 294 | 369 | 730 | 775 | 632 | 535 | 580 | 406 | 339 | 196 | 143 |
| Shopping | 445 | 655 | 705 | 875 | 1210 | 985 | 1100 | 1580 | 1210 | 445 | 152 | - |
| Social-Recreation | 450 | 272 | 179 | 358 | 358 | 536 | 895 | 1070 | 856 | 715 | 536 | 358 |
| School | 54 | 18 | 36 | 218 | 38 | 18 | 11 | 4 | - | 18 | - | - |
| TOTAL | 2175 | 1945 | 2359 | 4431 | 4841 | 4071 | 3011 | 3598 | 2708 | 1945 | 1248 | 929 |

TABLE 17 - AUTO PASSENGER TRIPS BY HOUR OF DAY AND PURPOSE

| Hour of Day (A.M.) | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Work | 76 | 27 | 40 | 4 | 40 | 97 | 545 | 698 | 272 | 125 | 49 | 89 |
| Personal Business | 46 | 21 | 11 | - | - | 21 | 113 | 226 | 173 | 113 | 138 | 144 |
| Shopping | - | - | - | - | - | - | - | 49 | 104 | 209 | 412 | 330 |
| Social-Recreation | 180 | 94 | 16 | - | - | - | - | 55 | 94 | 180 | 220 | 360 |
| School | - | - | - | - | - | - | 57 | 725 | 425 | 78 | 22 | 110 |
| TOTAL | 302 | 142 | 67 | 4 | 40 | 118 | 715 | 1753 | 1068 | 705 | 841 | 1033 |

| Hour of Day (P.M.) | 12-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Work | 174 | 147 | 224 | 470 | 515 | 398 | 97 | 76 | 49 | 89 | 76 | 89 |
| Personal Business | 183 | 138 | 173 | 342 | 363 | 296 | 250 | 272 | 190 | 159 | 92 | 67 |
| Shopping | 209 | 308 | 330 | 412 | 566 | 462 | 516 | 740 | 565 | 209 | 71 | - |
| Social Recreation | 455 | 274 | 180 | 360 | 360 | 540 | 900 | 1080 | 862 | 720 | 540 | 360 |
| School | 167 | 57 | 110 | 667 | 113 | 57 | 32 | 11 | - | 57 | - | - |
| TOTAL | 1188 | 924 | 1017 | 2251 | 1917 | 1753 | 1785 | 2179 | 1666 | 1234 | 779 | 516 |

TABLE 18 - SUBWAY AND STREETCAR TRIPS BY HOUR OF DAY AND PURPOSE

| Hour of Day (A.M.) | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Work | 67 | 24 | 35 | 4 | 35 | 86 | 480 | 613 | 240 | 110 | 43 | 79 |
| Personal Business | 8 | 4 | 2 | - | - | 4 | 19 | 38 | 29 | 19 | 23 | 24 |
| Shopping | - | - | - | - | - | - | - | 9 | 18 | 36 | 72 | 57 |
| Social-Recreation | 13 | 7 | 1 | - | - | - | - | 4 | 7 | 13 | 16 | 26 |
| School | - | - | - | - | - | - | 18 | 231 | 136 | 25 | 7 | 35 |
| TOTAL | 88 | 35 | 38 | 4 | 35 | 90 | 517 | 895 | 430 | 103 | 161 | 221 |

| Hour of Day (P.M.) | 12-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Work | 153 | 130 | 196 | 413 | 452 | 350 | 86 | 67 | 43 | 79 | 67 | 79 |
| Personal Business | 31 | 23 | 29 | 57 | 61 | 49 | 42 | 45 | 32 | 26 | 15 | 11 |
| Shopping | 36 | 54 | 57 | 72 | 99 | 81 | 90 | 129 | 99 | 36 | 12 | - |
| Social-Recreation | 32 | 20 | 13 | 26 | 26 | 38 | 64 | 77 | 61 | 51 | 38 | 26 |
| School | 53 | 18 | 35 | 212 | 36 | 18 | 10 | 3 | - | 18 | - | - |
| TOTAL | 305 | 245 | 330 | 780 | 674 | 536 | 292 | 321 | 235 | 210 | 132 | 116 |

TABLE 19 - BUS TRIPS BY HOUR OF DAY AND PURPOSE

| Hour of Day (A.M.) | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Work | 37 | 13 | 19 | 2 | 19 | 47 | 262 | 336 | 131 | 60 | 24 | 43 |
| Personal Business | 6 | 3 | 1 | - | - | 3 | 16 | 31 | 24 | 16 | 19 | 20 |
| Shopping | - | - | - | - | - | - | - | 7 | 15 | 30 | 60 | 48 |
| Social-Recreation | 17 | 9 | 1 | - | - | - | - | 5 | 9 | 17 | 21 | 34 |
| School | - | - | - | - | - | - | 31 | 404 | 236 | 43 | 12 | 62 |
| TOTAL | 60 | 25 | 21 | 2 | 19 | 50 | 309 | 783 | 415 | 166 | 136 | 207 |

| Hour of Day (P.M.) | 12-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Work | 84 | 71 | 108 | 226 | 247 | 191 | 47 | 37 | 24 | 43 | 37 | 43 |
| Personal Business | 25 | 19 | 24 | 48 | 50 | 41 | 35 | 38 | 26 | 22 | 13 | 9 |
| Shopping | 30 | 45 | 48 | 60 | 82 | 67 | 75 | 108 | 82 | 30 | 10 | - |
| Social Recreation | 43 | 26 | 17 | 34 | 34 | 51 | 84 | 101 | 81 | 67 | 51 | 34 |
| School | 93 | 31 | 62 | 372 | 63 | 31 | 18 | 6 | - | 31 | - | - |
| TOTAL | 275 | 192 | 259 | 740 | 476 | 381 | 259 | 290 | 213 | 193 | 111 | 86 |

TABLE 20 - WORK TRIPS BY HOUR OF DAY AND MODE

| Hour of Day (A.M.) | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auto Driver | 364 | 128 | 192 | 21 | 192 | 470 | 2610 | 3340 | 1310 | 600 | 236 | 428 |
| Auto Pass. | 76 | 27 | 40 | 4 | 40 | 97 | 545 | 698 | 272 | 125 | 49 | 89 |
| Subway, Streetcar | 67 | 24 | 35 | 4 | 35 | 86 | 480 | 613 | 240 | 110 | 43 | 79 |
| Bus Pass. | 37 | 13 | 19 | 2 | 19 | 47 | 262 | 336 | 131 | 60 | 24 | 43 |
| Other | 18 | 6 | 9 | 1 | 9 | 23 | 126 | 161 | 63 | 29 | 11 | 21 |

| Hour of Day (P.M.) | 12-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auto Driver | 835 | 706 | 1070 | 2250 | 2460 | 1900 | 470 | 364 | 236 | 428 | 364 | 428 |
| Auto Pass. | 174 | 147 | 224 | 470 | 515 | 398 | 97 | 76 | 49 | 89 | 76 | 89 |
| Subway, Streetcar | 153 | 130 | 196 | 413 | 452 | 350 | 86 | 67 | 43 | 79 | 67 | 79 |
| Bus Pass. | 84 | 71 | 108 | 226 | 247 | 191 | 47 | 37 | 24 | 43 | 37 | 43 |
| Other | 40 | 34 | 52 | 109 | 119 | 92 | 23 | 18 | 11 | 21 | 18 | 21 |

TABLE 21 - PERSONAL BUSINESS TRIPS BY HOUR OF DAY AND MODE

| Hour of Day (A.M.) | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auto Driver | 98 | 45 | 23 | - | - | 45 | 240 | 482 | 368 | 240 | 294 | 308 |
| Auto Pass. | 46 | 21 | 11 | - | - | 21 | 113 | 226 | 173 | 113 | 138 | 144 |
| Subway, Streetcar | 8 | 4 | 2 | - | - | 4 | 19 | 38 | 29 | 19 | 23 | 24 |
| Bus Pass. | 6 | 3 | 1 | - | - | 3 | 16 | 31 | 24 | 16 | 19 | 20 |
| Other | 4 | 1 | 1 | - | - | 2 | 9 | 18 | 14 | 9 | 11 | 11 |

| Hour of Day (P.M.) | 12-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auto Driver | 391 | 294 | 369 | 730 | 775 | 632 | 535 | 580 | 406 | 339 | 196 | 143 |
| Auto Pass. | 183 | 138 | 173 | 342 | 363 | 296 | 250 | 272 | 190 | 159 | 92 | 67 |
| Subway, Streetcar | 31 | 23 | 29 | 57 | 61 | 49 | 42 | 45 | 32 | 26 | 15 | 11 |
| Bus Pass. | 25 | 19 | 24 | 48 | 50 | 41 | 35 | 38 | 26 | 22 | 13 | 9 |
| Other | 14 | 11 | 14 | 27 | 28 | 23 | 20 | 21 | 15 | 12 | 7 | 5 |

TABLE 22 - SHOPPING TRIPS BY HOUR OF DAY AND MODE

| Hour of Day (A.M.) | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auto Driver | - | - | - | - | - | - | - | 106 | 223 | 445 | 875 | 705 |
| Auto Pass. | - | - | - | - | - | - | - | 49 | 104 | 209 | 412 | 330 |
| Subway, Streetcar | - | - | - | - | - | - | - | 9 | 18 | 36 | 72 | 57 |
| Bus Pass. | - | - | - | - | - | - | - | 7 | 15 | 30 | 60 | 48 |
| Other | - | - | - | - | - | - | - | 1 | 3 | 6 | 11 | 9 |

| Hour of Day (P.M.) | 12-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auto Driver | 445 | 655 | 705 | 875 | 1210 | 985 | 1100 | 1580 | 1210 | 445 | 152 | - |
| Auto Pass. | 209 | 308 | 330 | 412 | 566 | 462 | 516 | 740 | 565 | 209 | 71 | - |
| Subway, Streetcar | 36 | 54 | 57 | 72 | 99 | 81 | 90 | 129 | 99 | 36 | 12 | - |
| Bus Pass. | 30 | 45 | 48 | 60 | 82 | 67 | 75 | 108 | 82 | 30 | 10 | - |
| Other | 6 | 8 | 9 | 11 | 15 | 12 | 14 | 20 | 15 | 6 | 2 | - |

TABLE 23 - SOCIAL-RECREATION TRIPS BY HOUR OF DAY AND MODE

| Hour of Day (A.M.) | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auto Driver | 179 | 93 | 16 | - | - | - | - | 54 | 93 | 179 | 218 | 358 |
| Auto Pass. | 180 | 94 | 16 | - | - | - | - | 55 | 94 | 180 | 220 | 360 |
| Subway, Streetcar | 13 | 7 | 1 | - | - | - | - | 4 | 7 | 13 | 16 | 26 |
| Bus Pass. | 17 | 9 | 1 | - | - | - | - | 5 | 9 | 17 | 21 | 34 |
| Other | 6 | 3 | 1 | - | - | - | - | 2 | 3 | 6 | 8 | 13 |

| Hour of Day (P.M.) | 12-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auto Driver | 450 | 272 | 179 | 358 | 358 | 536 | 895 | 1070 | 856 | 715 | 536 | 358 |
| Auto Pass. | 455 | 274 | 180 | 360 | 360 | 540 | 900 | 1080 | 862 | 720 | 540 | 360 |
| Subway, Streetcar | 32 | 20 | 13 | 26 | 26 | 38 | 64 | 77 | 61 | 51 | 38 | 26 |
| Bus Pass. | 43 | 26 | 17 | 34 | 34 | 51 | 84 | 101 | 81 | 67 | 51 | 34 |
| Other | 16 | 10 | 6 | 13 | 13 | 19 | 32 | 39 | 31 | 26 | 19 | 13 |

TABLE 24 - SCHOOL TRIPS BY HOUR OF DAY AND MODE

| Hour of Day (A.M.) | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auto Driver | - | - | - | - | - | - | 18 | 236 | 139 | 25 | 7 | 36 |
| Auto Pass. | - | - | - | - | - | - | 57 | 725 | 425 | 78 | 22 | 110 |
| All Transit | - | - | - | - | - | - | 49 | 635 | 572 | 68 | 19 | 97 |
| Schoolbus | - | - | - | - | - | - | 95 | 1220 | 718 | 131 | 36 | 186 |
| Other | - | - | - | - | - | - | 3 | 44 | 26 | 5 | 1 | 7 |

| Hour of Day (P.M.) | 12-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auto Driver | 54 | 18 | 36 | 218 | 38 | 18 | 11 | 4 | - | 18 | - | - |
| Auto Pass. | 167 | 57 | 110 | 667 | 113 | 57 | 32 | 11 | - | 57 | - | - |
| All Transit | 146 | 49 | 97 | 584 | 99 | 49 | 28 | 9 | - | 49 | - | - |
| Schoolbus | 281 | 95 | 186 | 1130 | 190 | 95 | 55 | 18 | - | 95 | - | - |
| Other | 10 | 3 | 7 | 41 | 7 | 3 | 2 | 1 | - | 3 | - | - |

TABLE 25 - NEW COMMUNITY TRIP PRODUCTION

LONG ISLAND (39% of New Cummunity Population)

| TIME | PURPOSE | AUTO. DRIV. | AUTO. PASS | SUBWAY | BUS | SCHOOLBUS | TOTALS |
|---|---|---|---|---|---|---|---|
| 6-7 | Work | 1018 | 212 | 187 | 102 | | |
| | Personal Business | 94 | 44 | 7 | 6 | | |
| | Shopping | - | - | - | - | | |
| | Social-Recreation | - | - | - | - | | |
| | School | 7 | 22 | 7 | 12 | 37 | |
| TOTALS | | 1119 | 278 | 201 | 120 | 37 | 1755 |
| 7-8 | Work | 1300 | 272 | 239 | 131 | | |
| | Personal Business | 188 | 88 | 15 | 12 | | |
| | Shopping | 41 | 19 | 4 | 3 | | |
| | Social-Recreation | 21 | 21 | 1 | 2 | | |
| | School | 92 | 282 | 90 | 158 | 475 | |
| TOTALS | | 1642 | 682 | 349 | 346 | 475 | 3494 |
| 8-9 | Work | 510 | 106 | 94 | 51 | | |
| | Personal Business | 143 | 68 | 11 | 9 | | |
| | Shopping | 87 | 41 | 7 | 6 | | |
| | Social-Recreation | 36 | 37 | 3 | 4 | | |
| | School | 54 | 166 | 53 | 92 | 280 | |
| TOTALS | | 830 | 418 | 168 | 162 | 280 | 1858 |

TABLE 25 Continued - NEW COMMUNITY TRIP PRODUCTION

LONG ISLAND (39% of New Community Population)

| TIME | PURPOSE | AUTO. DRIV. | AUTO. PASS | SUBWAY | BUS | SCHOOLBUS | TOTALS |
|---|---|---|---|---|---|---|---|
| 3-4 | Work | 877 | 183 | 161 | 88 | | |
| | Personal Business | 285 | 133 | 22 | 19 | | |
| | Shopping | 341 | 161 | 28 | 23 | | |
| | Social-Recreation | 140 | 140 | 10 | 13 | | |
| | School | 85 | 260 | 83 | 145 | 440 | |
| TOTALS | | 1728 | 877 | 304 | 288 | 440 | 3637 |
| 4-5 | Work | 960 | 200 | 176 | 96 | | |
| | Personal Business | 302 | 142 | 24 | 19 | | |
| | Shopping | 472 | 220 | 39 | 32 | | |
| | Social-Recreation | 140 | 140 | 10 | 13 | | |
| | School | 15 | 44 | 14 | 25 | 74 | |
| TOTALS | | 1889 | 746 | 263 | 185 | 74 | 3157 |
| 5-6 | Work | 740 | 155 | 136 | 75 | | |
| | Personal Business | 246 | 115 | 19 | 16 | | |
| | Shopping | 384 | 180 | 32 | 26 | | |
| | Social-Recreation | 209 | 210 | 15 | 20 | | |
| | School | 7 | 22 | 7 | 12 | 37 | |
| TOTALS | | 1586 | 682 | 209 | 149 | 37 | 2663 |

TABLE 25 Continued - NEW COMMUNITY TRIP PRODUCTION

LONG ISLAND (39% of New Community Population)

| TIME | PURPOSE | AUTO. DRIV. | AUTO. PASS | SUBWAY | BUS | SCHOOLBUS | TOTALS |
|---|---|---|---|---|---|---|---|
| 6-7 | Work | 183 | 38 | 34 | 18 | | |
| | Personal Business | 208 | 98 | 16 | 14 | | |
| | Shopping | 430 | 201 | 35 | 29 | | |
| | Social-Recreation | 349 | 351 | 25 | 33 | | |
| | School | 43 | 12 | 4 | 7 | 21 | |
| TOTALS | | 1213 | 700 | 114 | 101 | 21 | 2149 |
| 7-8 | Work | 142 | 30 | 26 | 14 | | |
| | Personal Business | 226 | 106 | 18 | 15 | | |
| | Shopping | 616 | 288 | 50 | 42 | | |
| | Social-Recreation | 417 | 421 | 30 | 40 | | |
| | School | 1 | 4 | 1 | 2 | 7 | |
| TOTALS | | 1420 | 849 | 125 | 113 | 7 | 2496 |

TABLE 26 - NEW COMMUNITY TRIP PRODUCTION

THOMPSON ISLAND (29% of New Community Population)

| TIME | PURPOSE | AUTO. DRIV. | AUTO. PASS | SUBWAY | BUS | SCHOOLBUS | TOTALS |
|---|---|---|---|---|---|---|---|
| 6-7 | Work | 757 | 158 | 139 | 76 | | |
| | Personal Business | 70 | 33 | 6 | 5 | | |
| | Shopping | - | - | - | - | | |
| | Social-Recreation | - | - | - | - | | |
| | School | 5 | 17 | 5 | 9 | 28 | |
| TOTALS | | 832 | 208 | 150 | 90 | 28 | 1308 |
| 7-8 | Work | 969 | 202 | 178 | 97 | | |
| | Personal Business | 140 | 66 | 11 | 9 | | |
| | Shopping | 31 | 14 | 3 | 2 | | |
| | Social-Recreation | 16 | 16 | 1 | 1 | | |
| | School | 68 | 210 | 67 | 117 | 354 | |
| TOTALS | | 1224 | 508 | 260 | 226 | 354 | 2572 |
| 8-9 | Work | 380 | 79 | 70 | 38 | | |
| | Personal Business | 107 | 50 | 8 | 7 | | |
| | Shopping | 65 | 30 | 5 | 4 | | |
| | Social-Recreation | 27 | 27 | 2 | 3 | | |
| | School | 40 | 123 | 39 | 69 | 208 | |
| TOTALS | | 619 | 309 | 124 | 121 | 208 | 1381 |

TABLE 26 Continued - NEW COMMUNITY TRIP PRODUCTION

THOMPSON ISLAND (29% of New Community Population)

| TIME | PURPOSE | AUTO. DRIV. | AUTO. PASS | SUBWAY | BUS | SCHOOLBUS | TOTALS |
|---|---|---|---|---|---|---|---|
| 3-4 | Work | 653 | 136 | 120 | 66 | | |
| | Personal Business | 212 | 99 | 17 | 14 | | |
| | Shopping | 254 | 119 | 21 | 17 | | |
| | Social-Recreation | 104 | 104 | 8 | 10 | | |
| | School | 63 | 194 | 62 | 108 | 328 | |
| TOTALS | | 1286 | 652 | 228 | 215 | 328 | 2709 |
| 4-5 | Work | 714 | 149 | 131 | 72 | | |
| | Personal Business | 224 | 105 | 18 | 15 | | |
| | Shopping | 351 | 164 | 29 | 24 | | |
| | Social-Recreation | 104 | 104 | 8 | 10 | | |
| | School | 11 | 33 | 10 | 18 | 55 | |
| TOTALS | | 1404 | 555 | 196 | 139 | 55 | 2349 |
| 5-6 | Work | 550 | 150 | 101 | 55 | | |
| | Personal Business | 183 | 86 | 14 | 12 | | |
| | Shopping | 286 | 134 | 23 | 19 | | |
| | Social-Recreation | 155 | 157 | 11 | 15 | | |
| | School | 5 | 17 | 5 | 9 | 28 | |
| TOTALS | | 1179 | 544 | 154 | 110 | 28 | 2015 |

TABLE 26 Continued - NEW COMMUNITY TRIP PRODUCTION

THOMPSON ISLAND (29% of New Community Population)

| TIME | PURPOSE | AUTO. DRIV. | AUTO. PASS | SUBWAY | BUS | SCHOOLBUS | TOTALS |
|---|---|---|---|---|---|---|---|
| 6-7 | Work | 136 | 28 | 25 | 14 | | |
| | Personal Business | 155 | 73 | 12 | 10 | | |
| | Shopping | 319 | 150 | 26 | 22 | | |
| | Social-Recreation | 260 | 261 | 19 | 24 | | |
| | School | 3 | 9 | 3 | 5 | 16 | |
| TOTALS | | 873 | 521 | 85 | 75 | 16 | 1570 |
| 7-8 | Work | 106 | 22 | 19 | 11 | | |
| | Personal Business | 168 | 79 | 13 | 11 | | |
| | Shopping | 459 | 214 | 37 | 31 | | |
| | Social-Recreation | 310 | 314 | 22 | 29 | | |
| | School | 1 | 3 | 1 | 2 | 5 | |
| TOTALS | | 1044 | 632 | 92 | 84 | 5 | 1857 |

TABLE 27 - NEW COMMUNITY TRIP PRODUCTION

SPECTACLE ISLAND (19% of New Community Population)

| TIME | PURPOSE | AUTO. DRIV. | AUTO. PASS | SUBWAY | BUS | SCHOOLBUS | TOTALS |
|---|---|---|---|---|---|---|---|
| 6-7 | Work | 496 | 103 | 91 | 50 | | |
| | Personal Business | 46 | 20 | 4 | 3 | | |
| | Shopping | - | - | - | - | | |
| | Social-Recreation | - | - | - | - | | |
| | School | 3 | 11 | 3 | 6 | 18 | |
| TOTAL | | 545 | 134 | 98 | 59 | 18 | 854 |
| 7-8 | Work | 635 | 133 | 116 | 64 | | |
| | Personal Business | 92 | 43 | 7 | 6 | | |
| | Shopping | 20 | 9 | 2 | 1 | | |
| | Social-Recreation | 10 | 10 | 1 | 1 | | |
| | School | 45 | 138 | 44 | 77 | 232 | |
| TOTAL | | 802 | 333 | 170 | 149 | 232 | 1686 |
| 8-9 | Work | 249 | 52 | 46 | 25 | | |
| | Personal Business | 70 | 33 | 55 | 46 | | |
| | Shopping | 42 | 20 | 3 | 3 | | |
| | Social-Recreation | 18 | 18 | 1 | 2 | | |
| | School | 26 | 81 | 26 | 45 | 136 | |
| TOTAL | | 405 | 204 | 131 | 121 | 136 | 997 |

TABLE 27 Continued - NEW COMMUNITY TRIP PRODUCTION

SPECTACLE ISLAND (19% of New Community Population)

| TIME | PURPOSE | AUTO. DRIV. | AUTO. PASS | SUBWAY | BUS | SCHOOLBUS | TOTALS |
|---|---|---|---|---|---|---|---|
| 3-4 | Work | 428 | 89 | 79 | 43 | | |
| | Personal Business | 139 | 65 | 11 | 9 | | |
| | Shopping | 166 | 78 | 14 | 11 | | |
| | Social-Recreation | 68 | 68 | 5 | 6 | | |
| | School | 41 | 127 | 40 | 71 | 214 | |
| TOTAL | | 842 | 427 | 149 | 140 | 214 | 1772 |
| 4-5 | Work | 468 | 98 | 86 | 47 | | |
| | Personal Business | 147 | 69 | 12 | 10 | | |
| | Shopping | 230 | 108 | 19 | 16 | | |
| | Social-Recreation | 68 | 68 | 5 | 6 | | |
| | School | 7 | 21 | 7 | 12 | 36 | |
| TOTAL | | 920 | 364 | 129 | 91 | 36 | 1540 |
| 5-6 | Work | 361 | 76 | 67 | 36 | | |
| | Personal Business | 120 | 56 | 9 | 8 | | |
| | Shopping | 187 | 88 | 15 | 13 | | |
| | Social-Recreation | 102 | 103 | 7 | 10 | | |
| | School | 3 | 11 | 3 | 6 | 18 | |
| TOTAL | | 773 | 334 | 101 | 73 | 18 | 1299 |

TABLE 27 Continued - NEW COMMUNITY TRIP PRODUCTION

SPECTACLE ISLAND (19% of New Community Population)

| TIME | PURPOSE | AUTO. DRIV. | AUTO. PASS | SUBWAY | BUS | SCHOOLBUS | TOTALS |
|---|---|---|---|---|---|---|---|
| 6-7 | Work | 89 | 18 | 16 | 9 | | |
| | Personal Business | 102 | 48 | 8 | 7 | | |
| | Shopping | 209 | 98 | 17 | 14 | | |
| | Social-Recreation | 170 | 171 | 12 | 16 | | |
| | School | 2 | 6 | 2 | 3 | 10 | |
| TOTAL | | 572 | 341 | 55 | 49 | 10 | 1027 |
| 7-8 | Work | 69 | 14 | 13 | 7 | | |
| | Personal Business | 110 | 52 | 9 | 7 | | |
| | Shopping | 300 | 141 | 24 | 21 | | |
| | Social-Recreation | 203 | 205 | 15 | 19 | | |
| | School | 1 | 2 | 1 | 1 | 3 | |
| TOTAL | | 683 | 414 | 62 | 55 | 3 | 1217 |

TABLE 28 - NEW COMMUNITY TRIP PRODUCTION

COLUMBIA POINT (13% of New Community Population)

| TIME | PURPOSE | AUTO. DRIV. | AUTO. PASS | SUBWAY | BUS | SCHOOLBUS | TOTALS |
|---|---|---|---|---|---|---|---|
| 6-7 | Work | 340 | 71 | 63 | 34 | | |
| | Personal Business | 31 | 15 | 2 | 2 | | |
| | Shopping | - | - | - | - | | |
| | Social-Recreation | - | - | - | - | | |
| | School | 2 | 7 | 2 | 4 | 12 | |
| TOTAL | | 373 | 93 | 67 | 40 | 12 | 585 |
| 7-8 | Work | 430 | 91 | 80 | 44 | | |
| | Personal Business | 63 | 29 | 5 | 4 | | |
| | Shopping | 14 | 6 | 1 | 1 | | |
| | Social-Recreation | 7 | 7 | 1 | 1 | | |
| | School | 31 | 94 | 30 | 53 | 159 | |
| TOTAL | | 545 | 227 | 117 | 103 | 159 | 1151 |
| 8-9 | Work | 170 | 35 | 31 | 17 | | |
| | Personal Business | 48 | 23 | 4 | 3 | | |
| | Shopping | 29 | 14 | 2 | 2 | | |
| | Social-Recreation | 12 | 12 | 1 | 1 | | |
| | School | 18 | 55 | 18 | 31 | 93 | |
| TOTAL | | 277 | 139 | 56 | 54 | 93 | 619 |

TABLE 28 Continued - NEW COMMUNITY TRIP PRODUCTION

COLUMBIA POINT (13% of New Community Population)

| TIME | PURPOSE | AUTO. DRIV. | AUTO. PASS | SUBWAY | BUS | SCHOOLBUS | TOTALS |
|---|---|---|---|---|---|---|---|
| 3-4 | Work | 292 | 61 | 54 | 29 | | |
| | Personal Business | 95 | 44 | 7 | 6 | | |
| | Shopping | 114 | 54 | 9 | 8 | | |
| | Social-Recreation | 47 | 47 | 3 | 4 | | |
| | School | 28 | 87 | 28 | 48 | 147 | |
| TOTAL | | 576 | 293 | 101 | 95 | 147 | 1212 |
| 4-5 | Work | 320 | 67 | 59 | 32 | | |
| | Personal Business | 101 | 47 | 8 | 7 | | |
| | Shopping | 157 | 74 | 13 | 11 | | |
| | Social-Recreation | 47 | 47 | 3 | 4 | | |
| | School | 5 | 15 | 5 | 8 | 25 | |
| TOTAL | | 630 | 250 | 88 | 62 | 25 | 1055 |
| 5-6 | Work | 247 | 52 | 46 | 25 | | |
| | Personal Business | 82 | 38 | 6 | 5 | | |
| | Shopping | 128 | 60 | 11 | 9 | | |
| | Social-Recreation | 70 | 70 | 5 | 7 | | |
| | School | 2 | 7 | 2 | 4 | 12 | |
| TOTAL | | 529 | 227 | 70 | 50 | 12 | 888 |

TABLE 28 Continued - NEW COMMUNITY TRIP PRODUCTION

COLUMBIA POINT (13% of New Community Population)

| TIME | PURPOSE | AUTO. DRIV. | AUTO. PASS | SUBWAY | BUS | SCHOOLBUS | TOTALS |
|---|---|---|---|---|---|---|---|
| 6-7 | WORK | 61 | 13 | 11 | 6 | | |
| | Personal Business | 70 | 33 | 5 | 5 | | |
| | Shopping | 143 | 67 | 12 | 10 | | |
| | Social-Recreation | 116 | 117 | 8 | 11 | | |
| | School | 1 | 4 | 1 | 2 | 7 | |
| TOTAL | | 391 | 234 | 37 | 34 | 7 | 703 |
| 7-8 | Work | 47 | 10 | 9 | 5 | | |
| | Personal Business | 75 | 35 | 6 | 5 | | |
| | Shopping | 206 | 96 | 17 | 14 | | |
| | Social-Recreation | 139 | 141 | 10 | 13 | | |
| | School | 1 | 1 | 0 | 1 | 2 | |
| TOTAL | | 468 | 283 | 42 | 38 | 2 | 833 |